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ACOUSTIC TESTING OF A 1.5 PRESSURE RATIO LOW TIP SPEED FAN WITH CASING TIP BLEED (QEP FAN B SCALE MODEL)

by

S.B. Kazin, W.R. Minzner, and J.E. Paas

GENERAL ELECTRIC COMPANY

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16. Abstract

A scale model of the bypass flow region of a 1.5 pressure ratio, single stage, low tip speed fan was tested with a rotor tip casing bleed slot to determine its effects on noise generation. The bleed slot was located 1/2 inch (1.3 cm) upstream of the rotor leading edge and was configured to be a continuous opening around the circumference. The bleed manifold system was operated over a range of bleed rates corresponding to as much as 6% of the fan flow at approach thrust and 4.25% of the fan flow at takeoff thrust.

Acoustic results indicate that a bleed rate of 4% of the fan flow reduces the fan maximum approach 200 foot (61.0 m) sideline PNL 0.5 PNdB and the corresponding takeoff thrust noise 1.1 PNdB below the level with zero bleed. However, comparison of the standard casing (no bleed slot) and the slotted bleed casing with zero bleed shows that the bleed slot itself caused a noise increase.

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I. ABSTRACT

A scale model of the bypass flow region of a 1.5 pressure ratio, single stage, low tip speed fan was tested with a rotor tip casing bleed slot to determine its effects on noise generation. The bleed slot was located ½ inch (1.3 cm) upstream of the rotor leading edge and was configured to be a continuous opening around the circumference. The bleed manifold system was operated over a range of bleed rates corresponding to as much as 6% of the fan flow at approach thrust and 4.25% of the fan flow at takeoff thrust.

Acoustic results indicate that a bleed rate of 4% of the fan flow reduces the fan maximum approach 200 foot (61.0 m) sideline PNL 0.5 PNdB and the corresponding takeoff thrust noise 1.1 PNdB below the level with zero bleed. However, comparison of the standard casing (no bleed slot) and the slotted bleed casing with zero bleed shows that the bleed slot itself caused a noise increase.

II. SUMMARY

A scale model fan, designated "Fan B," was utilized to determine the acoustic characteristics of a single stage fan designed for a corrected tip speed of 1160 ft/sec (353.6 m/sec) at a bypass pressure ratio of 1.5. The fan had 26 rotor blades and 60 vanes with 2 rotor aerodynamic chord spacing between the rotor and the OGV's. The scale model fan which represented a .484 linear scale model version of the NASA/GE Quiet Engine Program full scale Fan B, simulated the bypass flow region through the fan.

The scale model was tested with a rotor tip casing bleed slot located ½ inch (1.3 cm) upstream of the leading edge of the rotor tip. The slot which was continuous circumferentially, blended into the original casing contour. The bleed system was designed to provide a uniform flow around the circumference as the low velocity air along the wall was bled. The system was capable of bleed rates up to 6% of the fan flow at approach thrust and 4.25% of the fan flow at takeoff thrust.

The scale model was tested to determine the effects of speed and bleed rates on noise generation. Acoustic data was recorded at ten speed points covering a range from 30% to 100% sea level static thrust. Two bleed rates, zero bleed and 4% of the fan flow, were investigated for this sequence of speed points. The 4% bleed rate was determined, during aerodynamic testing, to be sufficient to remove the boundary layer in front of the rotor; therefore, acoustic results obtained with 4% bleed as well as with a bleed casing baseline of zero bleed were extensively examined. Bleed rates of 2% and 3% of the fan flow were also checked at approach and takeoff thrust levels. All bleed tests were run with acoustic treatment in the fan frame.

The data derived at each of these test points was scaled up to full scale to evaluate the projected effectiveness for each case in reducing the noise of the fan system. Full scale projections indicate the bleed results would be lower than the results of the bleed casing without bleed flow but would be higher than the standard casing (no bleed slot) baseline. The following table shows the full scale, single fan, 200 foot (61.0) sideline maximum Perceived Noise Levels (PNL) in both the front and rear quadrant for approach and takeoff thrust:

FULL SCALE FAN B PROJECTIONS
200 FOOT (61.0 m) SIDELINE, MAXIMUM PNL
SINGLE FAN

	Front Quadrant		Rear Quadrant	
	Approach*	Takeoff**	Approach*	Takeoff**
0% Bleed	102.5 PNdB	112.5 PNdB	104.1 PNdB	115.6 PNdB
2% Bleed	102.2 PNdB	113.3 PNdB	104.0 PNdB	115.5 PNdB
3% Bleed	101.3 PNdB	113.1 PNdB	103.7 PNdB	115.3 PNdB
4% Bleed	100.0 PNdB	111.6 PNdB	103.6 PNdB	114.5 PNdB
Standard Casing	98.0 PNdB	109.9 PNdB	100.2 PNdB	112.4 PNdB

* 6,684 pounds (29,744 newtons) static fan thrust
**17,140 pounds (76,277 newtons) static fan thrust

The results from the bleed casing configuration indicate that noise decreased with bleed at the harmonic tones as well as in the broadband noise. However, this particular tip bleed casing configuration did not reduce the noise below the level of the standard casing configuration.

III. INTRODUCTION

This report describes work performed by the General Electric Company for the NASA-Lewis Research Center on the Experimental Quiet Engine Program. The major objectives of this program were:

(1) To determine the noise levels produced by turbofan bypass engines designed for low noise output and to confirm that predicted noise reductions can be achieved;

(2) To demonstrate the technology and innovations which will reduce the production and radiation of noise in turbofan engines;

(3) To acquire experimental acoustic and aerodynamic data for high bypass turbofan engines from which acoustic theory and experience can be correlated to provide a better understanding of the noise production mechanisms.

A scale model fan program was utilized to provide information pertinent to achieving these objectives. The results of the scale model testing provided directly applicable experimental data on noise reduction features that might be applied to full size fan systems. Experience indicates that such scale model acoustic tests provide accurate and effective means to readily evaluate such low noise design configurations.

Fan B was incorporated into the NASA/GE Quiet Engine Program to investigate the noise generating and radiating characteristics of a low speed, moderately loaded, single stage fan. The Fan B scale model, the first scaled fan tested, was approximately a half scale version (48.4%) of the full size fan and it essentially reproduced the bypass flow region through Fan B.

The tip of fans and compressors has long been a source of aerodynamic performance problems. These difficulties arise, principally, from reverse flow from the downstream side of the rotor and the low velocity inlet air due to the formation of the upstream casing boundary layer. The impingement of the outer casing boundary layer on the tip region of the rotor blade results in considerable local increase in the incidence angle and subsequent increasing of the tip airfoil's wake width and velocity decrement. This wake, in turn, interacts with the OGV, raising the possibility of increased tone noise generation.

Another way in which the boundary layer creates noise is through the impact of turbulent eddies on the rotor tip which set up random fluctuations in lift. These lift fluctuations could result in the generation of random or broadband noise.

Thus, the replacement of this low momentum air with higher velocity, low turbulence level fluid may reduce the level of both tone and broadband noise. The degree of reduction that might be obtained is dependent on the relative magnitude of the tip generated noise to the noise of the same frequency generated elsewhere in the stage and on the cleanliness with which the momentum replacement is accomplished. It is possible, of course, to actually increase the fan noise levels while replacing the low momentum air if the replacement technique produces a velocity profile which contains greater momentum losses or introduces increased turbulence levels within the boundary layer.

One of the methods by which the air velocity in the vicinity of the casing may be increased is to bleed off the low momentum air and allow higher momentum

free stream air to approach the wall. This may be accomplished through a bleed slot (or slots) located upstream of the rotor, configured so as to be continuous around the circumference. (Discontinuous slots may set up a periodic disturbance to the rotor which would generate noise at the blade passing frequency and its harmonics). Such a tip bleed approach was investigated. A description of the tip bleed slot used in this series of acoustic tests appears in the following section.

The effects of the tip bleed on the noise characteristics of the scale model Fan B were examined during acoustic testing for various fan speeds and bleed rates. Acoustic data were recorded at speed points corresponding to a range from 30% to 100% sea level static thrust, for bleed rates ranging from 0% to 4% of the bypass flow. The results obtained with the tip bleed configuration were compared to data for the standard casing (baseline) configuration. The data obtained at each test point were also scaled up to full scale and compared to scaled-up baseline results in order to evaluate the projected effectiveness of the tip bleed as a method of reducing the fan system noise. Note that both configurations contained fan frame acoustic treatment.

Further details on the acoustically treated baseline configuration are contained in the scale model NASA/GE Fan B report[1] comparing configurations with and without the acoustic frame treatment.

[1] Kazin, S.B., Minzner, W.R., and Paas, J.E., "Acoustic Testing of a 1.5 Pressure Ratio Low Tip Speed Fan (QEP Fan B Scale Model)," NASA CR-120789.

IV. TEST VEHICLE DESCRIPTION

Full scale Fan B is a low speed, moderately loaded, single stage fan. It has been designed at the altitude cruise condition for a corrected tip speed of 1160 ft/sec (353.6 m/sec), at a bypass pressure ratio of 1.5 and with a corrected fan flow of 950 lb/sec (430.9 kg/sec). This fan incorporates 26 shroudless rotor blades and 60 outlet guide vane (OGV's) with a rotor-OGV spacing of two aerodynamic rotor chords to minimize noise generation.

The scale model used to determine the acoustic characteristics of different low noise designs, essentially simulated the bypass portion (outer 84.5% of flow) of the full size Fan B, as shown schematically in Figure 1. The design basis was to provide the same corrected tip speed, pressure ratio and weight flow per unit area as the bypass portion of the full scale Fan B. To maintain the bypass pressure ratio on the scale model, it was necessary to increase the loading at the hub to account for the end-wall-blade boundary layer interaction. Some pertinent scale model and full scale characteristics are shown in Table I.

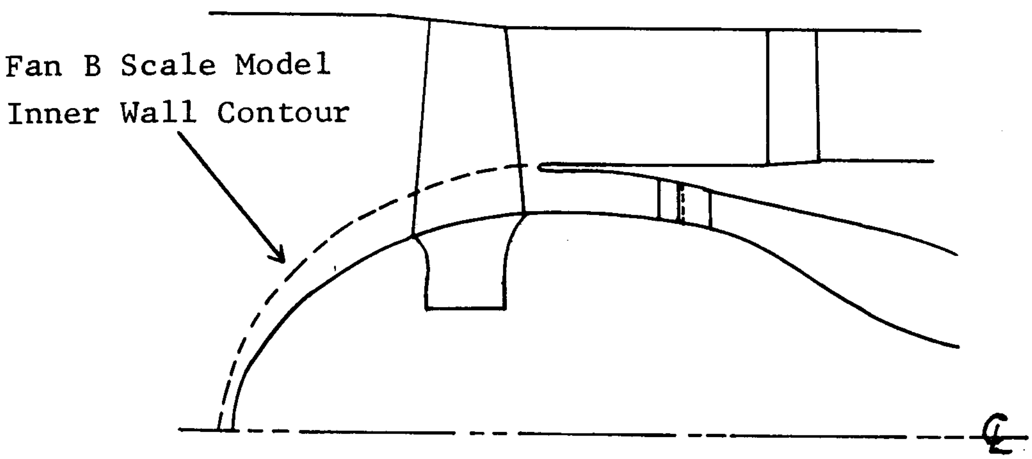
The acoustic treatment of the fan frame area was scaled from the full scale fan and incorporated in the scale model. Figure 2 shows a cross section of the fan without the bleed casing, indicating the location of the acoustic treatment. The amount of acoustic treatment at each location is listed in Table II. The areas shown are effective areas, allowing for fasterners, assembly methods, rake pads, support ribs, etc. The treatment material used on the scaled fan was Scottfelt 3-900, ½" (1.3 cm) an open-celled poylurethane foam material, having wide bandwidth suppression characteristics similar to the Multiple-Degree-of-Freedom resonator suprression material used on the full

scale vehicle. The scale model treatment was held in position by means of a perforated face plate with 1/16 inch diameter holes and a porosity of 22½%.

The only necessary change to this fan frame treated configuration in order to run the tip bleed tests was the addition of the bleed casing as shown in Figure 3. This bleed casing consisted of a continuous circumferential slot, located ½ inch (1.3 cm) ahead of the leading edge of the rotor tip, blended into the original casing contour. Air passed through the slot into an annular collector and was drawn off through a manifold arrangement consisting of six equally spaced ports, to provide a uniform flow arround the circumference.

As shown in the system schematic drawing, Figure 4, the six ports were directed to a common line. The bleed flow as drawn off by means of a centrifugal fan located in an acoustic enclosure. Inlet and exhaust silencers were placed in the line, as shown, to provide system noise levels sufficiently below that of the test vehicle.

The bleed rate was regulated by means of pneumatically controlled butterfly valves, with measurements made by means of an orifice plate. The bypass ducting was used to permit the centrifugal fan to operate at a constant flow rate, without surging, regardless of the bleed rate desired.



Schematic of Fan B

Figure 1

TABLE I

QEP FAN B

FULL SCALE AND SCALE MODEL CHARACTERISTICS

SEA LEVEL STATIC, STD. DAY

TAKEOFF POWER - 91% FAN SPEED

	Full Scale	Scale Model
Fan Speed, RPM	3299	6814
Tip Speed, Ft/Sec (M/Sec)	1055 (322)	1055 (322)
Bypass Total Pressure Ratio	1.415	1.415
Bypass Flow, Lb/Sec (Kg/Sec)	692 (313.9)	162 (73.5)
Fan Duct Thrust, Lbs (Newtons)	17,140 (76,277)	4010 (17,844)
Rotor Inlet Tip Diameter, Inches (M)	73.35 (1.9)	35.5 (.9)
Inlet Hub/Tip Ratio	.465	.579
Number of Rotor Blades	26	26
Number of OGV's	60	60

FAN B SCALE MODEL
CROSS SECTION INDICATING LOCATION OF ACOUSTIC TREATMENT
WITHOUT BLEED CASING

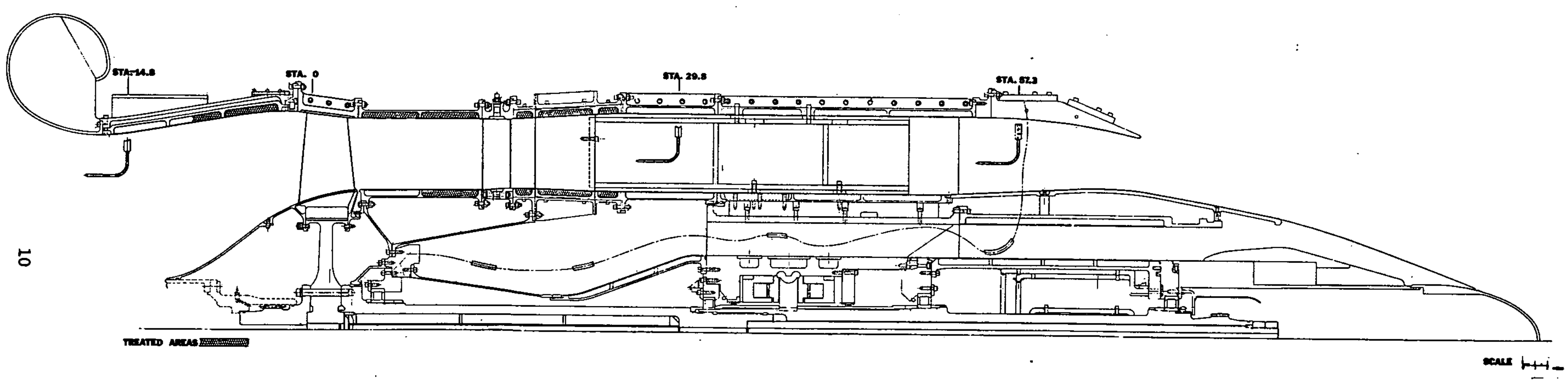


Figure 2

TABLE II

QEP SCALE MODEL FAN B

ACOUSTIC TREATMENT AREAS

LOCATION	AREA	
Inlet	812 in^2	5240 cm^2
Rotor - OGV's		
Inner Wall	315 in^2	2030 cm^2
Outer Wall	1007 in^2	6500 cm^2
Aft of OGV's		
Inner Wall	417 in^2	2690 cm^2
Outer Wall	668 in^2	4310 cm^2
Total	3219 in^2	20,770 cm^2
	22.4 ft^2	2.08 m^2

FAN B SCALE MODEL

COMPARISON OF STANDARD AND BLEED CASING

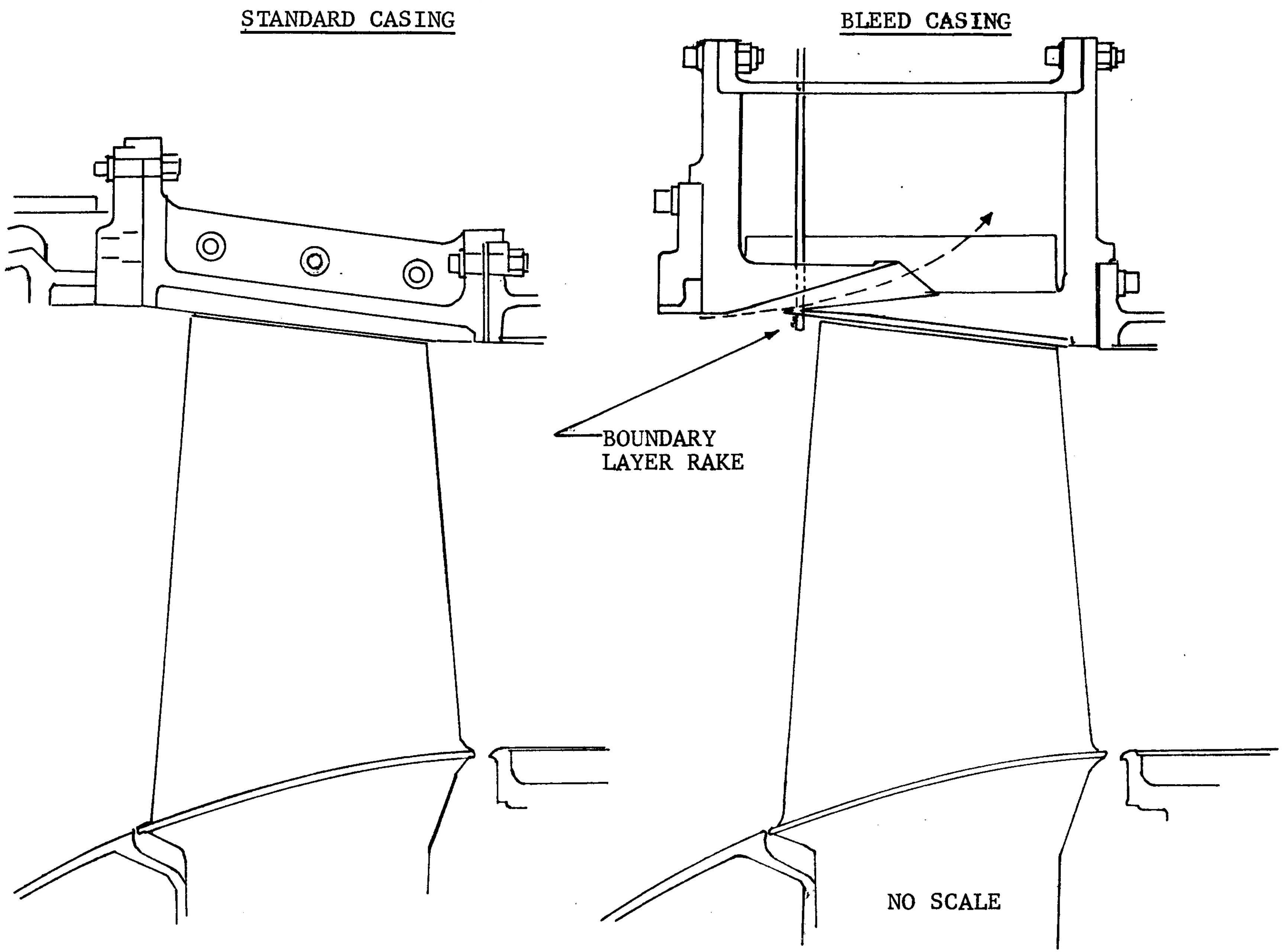


Figure 3

BLEED SYSTEM SCHEMATIC

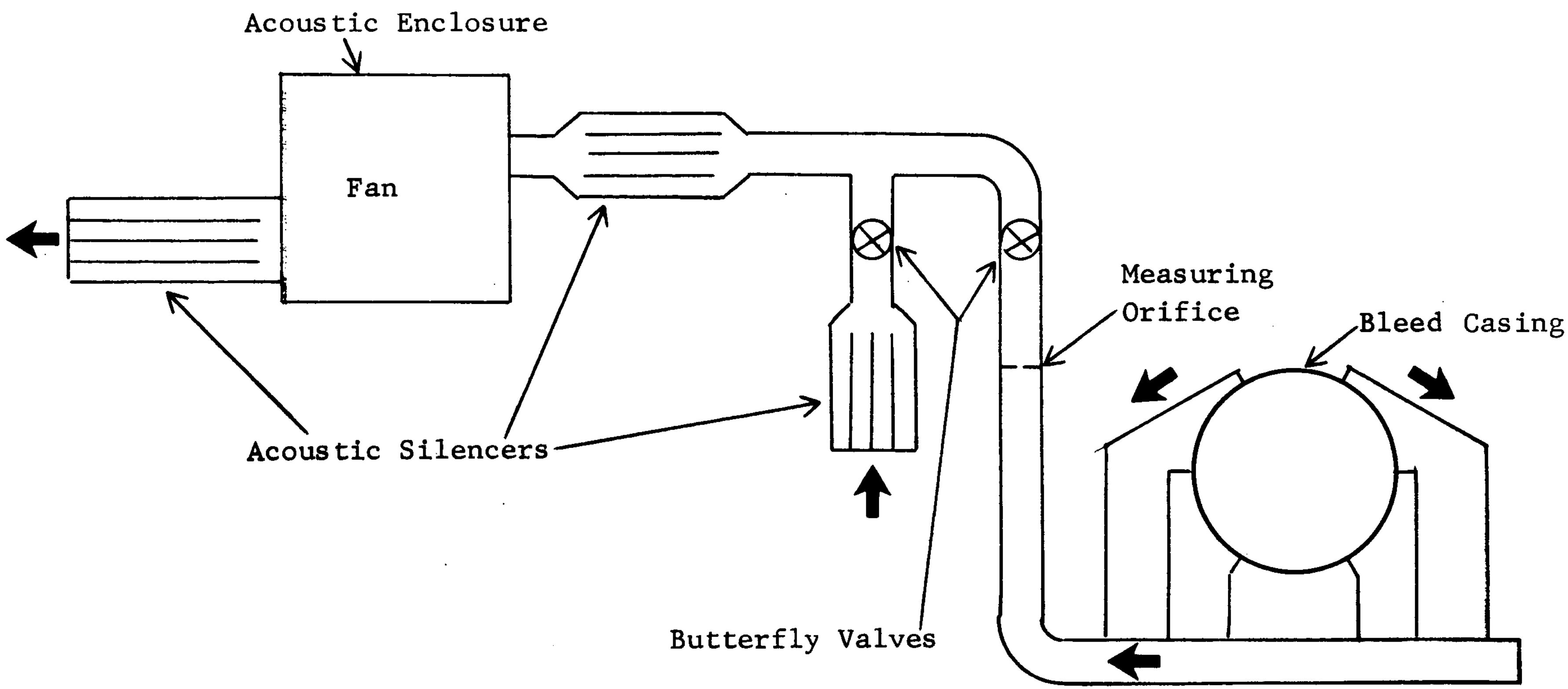


Figure 4

V. Test Program

Testing of the scale model vehicle was performed at the Peebles Test Operation, General Electric's out-door test facility shown in Figures 5 and 6. Testing was performed on Site 4B, using a G.E. LM1500 stationary gas turbine as the drive system. Figure 7 shows a typical scale model vehicle installation. As can be seen, the scale model fans were driven from the front to eliminate noise generation by discharge flow over the drive structures.

Table III summarizes the testing of the bleed configuration with bleed rates of 0%, 2%, 3% and 4% of the bypass weight flow. The speeds selected correspond to the net engine thrusts shown below:

RPM	% SPEED	% F_n SLS *	% F_n alt=0 M = .25 **
4040	54.0	29.5	22.3
4474	59.8	36.8	30.6
4700	62.8	40.9	35
4907	65.5	45.2	40
5505	73.5	58.6	55
5990	80	71.1	70
6354	84.9	81.9	82.5
6526	87.1	88.4	90
6649	88.8	92.9	95
6845	91.4	100	102.5

* 100% = 22,000 lbs (97,900 newtons) full scale
** 100% = 16,000 lbs (71,200 newtons) full scale

These physical speeds were set in order to avoid shifting the frequency of the tones between 1/3 octave bands due to day to day ambient temperature variations.

Moreover, the following restrictions were imposed on acoustic testing:

1. Acoustic data were not taken with steady winds greater than 5 mph. (8.05 km/sec) or gusts greater than 3 mph. (4.83 km/sec);

2. Water or snow accumulation on the sound field prohibited testing;

3. Rain, snow or fog at the test site prohibited testing;

4. Testing was restricted to conditions where the relative humidity was greater than 30% and lower than 90%;

5. No absolute level acoustic data was taken while aerodynamic instrumentation was installed.

The acoustic data was taken[2] with microphones located on a 100 foot (30.5 m) arc, positioned at 10 degree increments from 20° to 160° as measured from the fan inlet centerline at the rotor leading edge. The microphones were set at the height of the fan centerline, 12 feet (3.7 m) above the sound field surface. This sound field surface consisted of a level, 250 ft. (76.2 m) arc of crushed stone. The 1/3 octave scale model data used to prepare this report are presented in the Appendix, Section VII.

In addition to providing comparative data on noise reduction features, the scale model results were used to predict the full scale fan noise levels.

[2] Kazin, S.B., Minzner, W.R., and Paas, J.E., "Acoustic Testing of a 1.5 Pressure Ratio, Low Tip Speed Fan (QEP Fan B Scale Model)," NASA CR-120789, pp 13, 17 and 20-25.

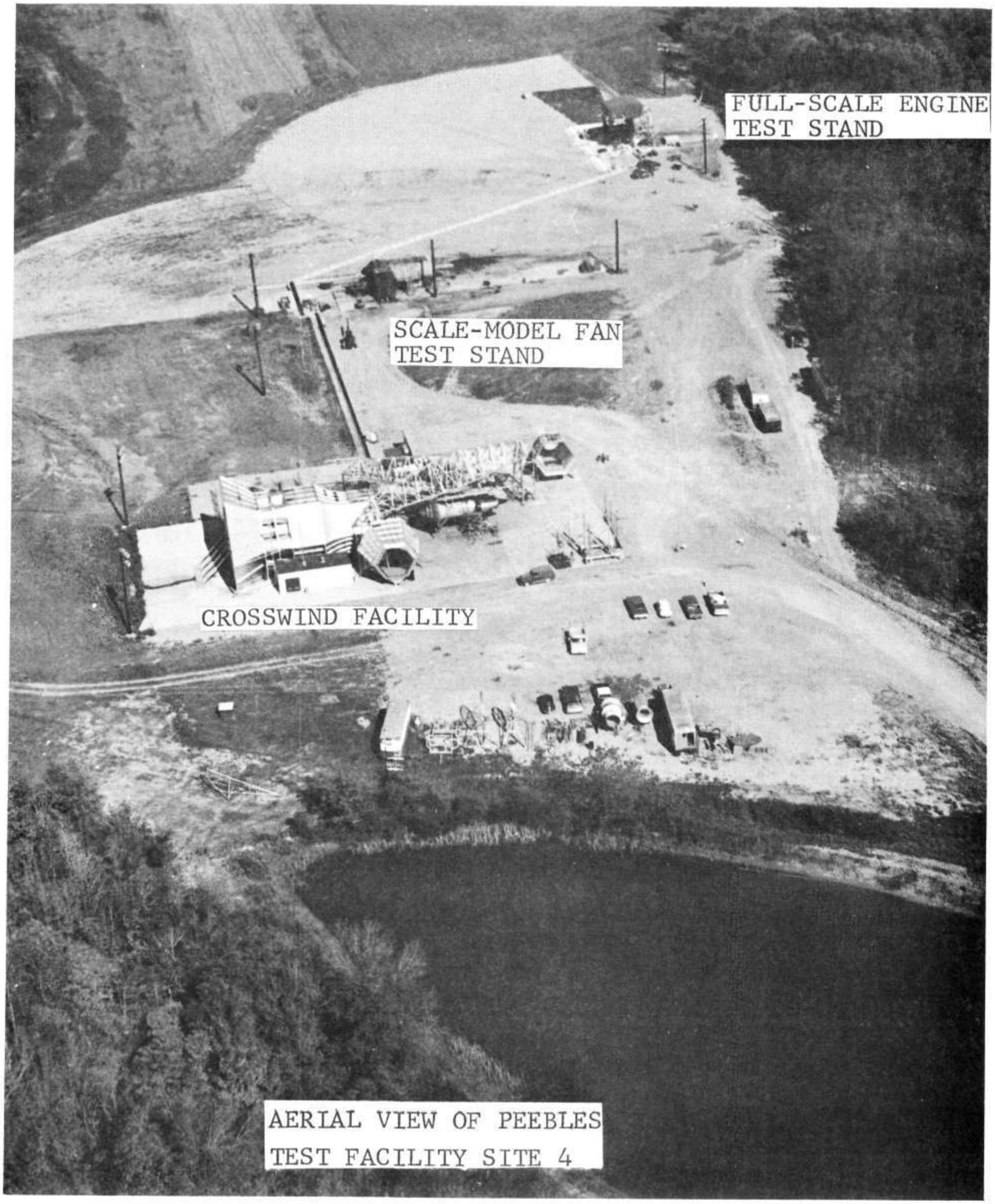

FULL-SCALE ENGINE TEST STAND
SCALE-MODEL FAN TEST STAND
CROSSWIND FACILITY
AERIAL VIEW OF PEEBLES TEST FACILITY SITE 4

FIGURE 5

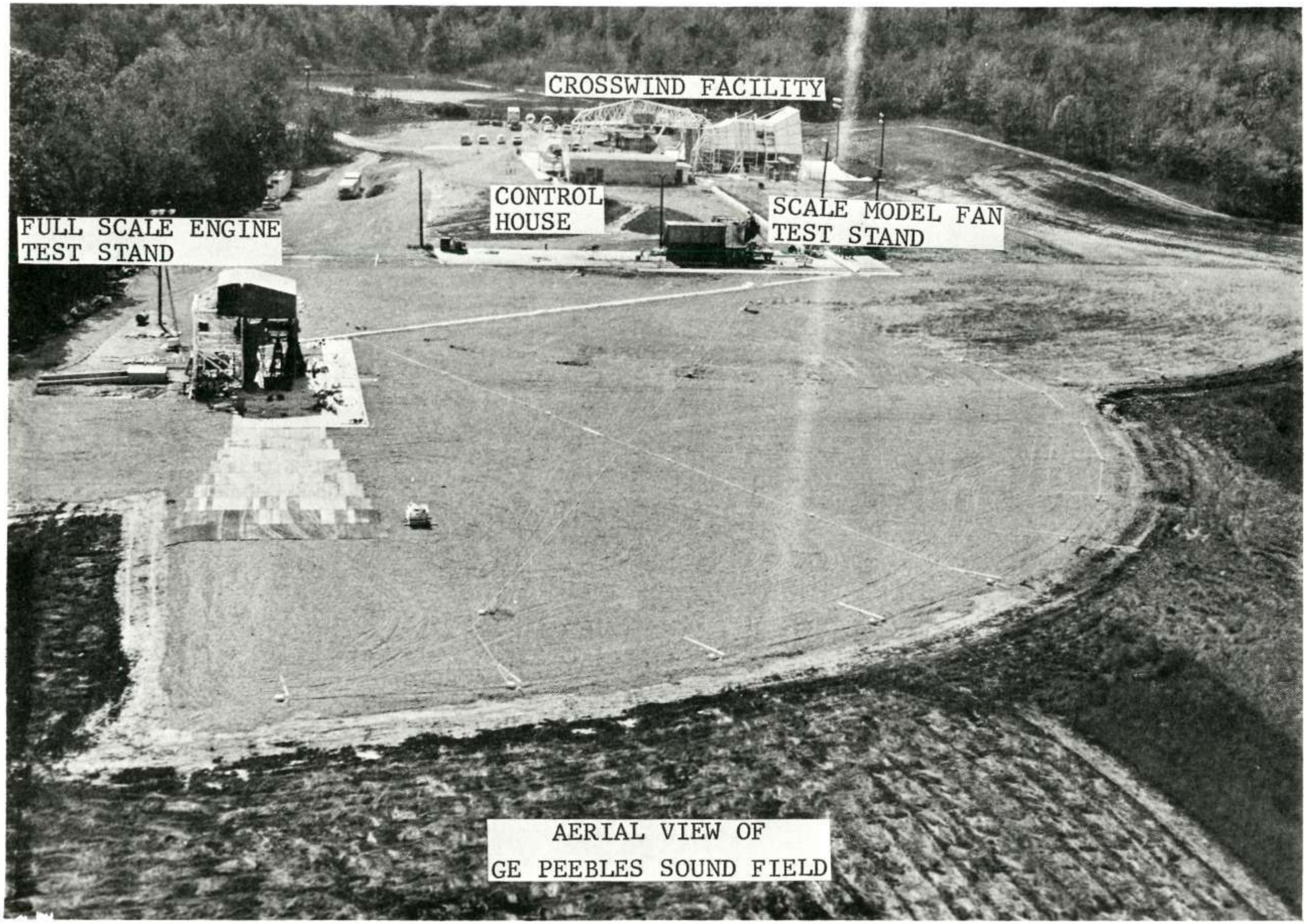

CROSSWIND FACILITY
CONTROL HOUSE
FULL SCALE ENGINE TEST STAND
SCALE MODEL FAN TEST STAND
AERIAL VIEW OF
GE PEEBLES SOUND FIELD

Figure 6

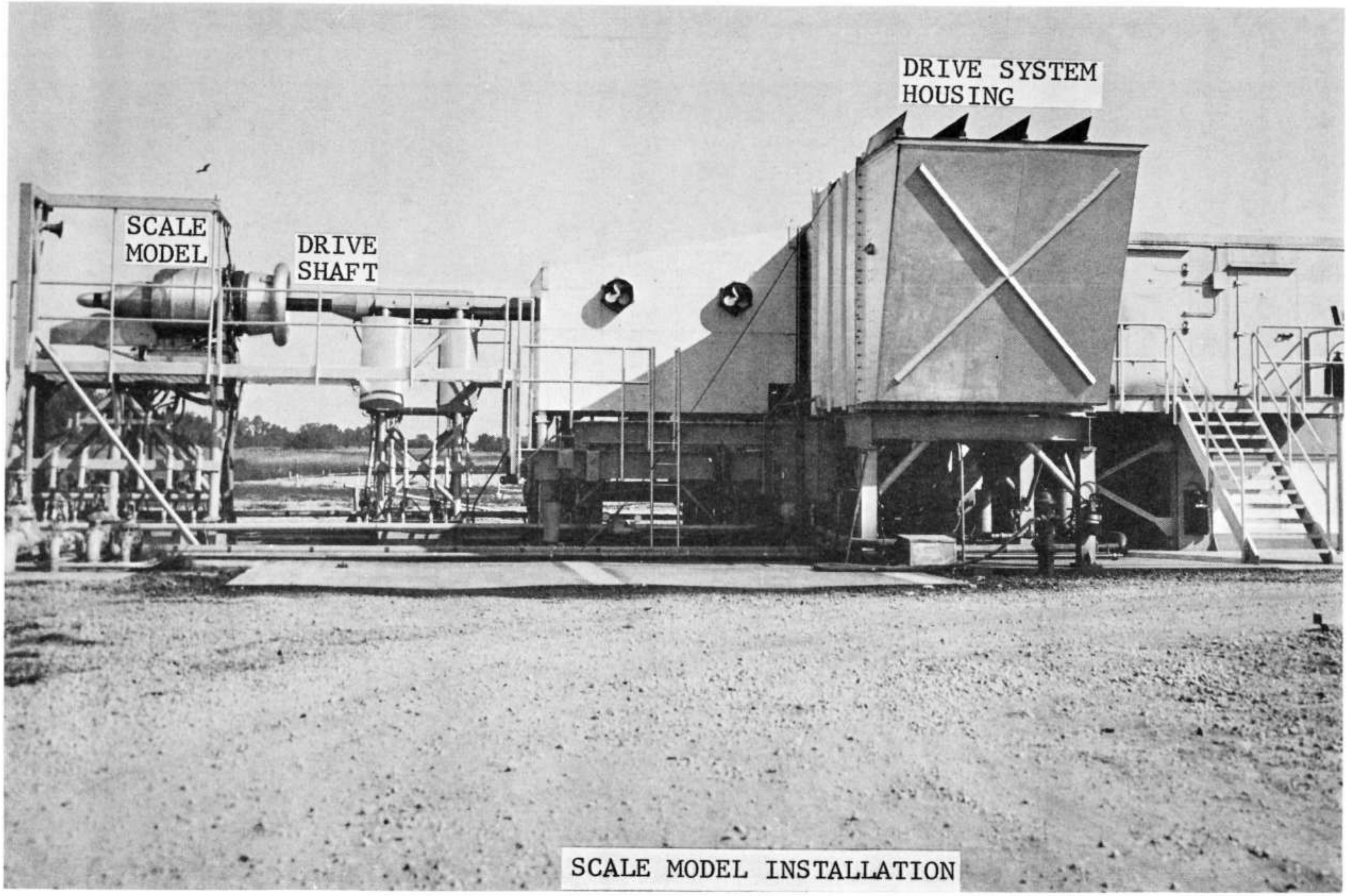

SCALE
MODEL
DRIVE
SHAFT
DRIVE SYSTEM
HOUSING
SCALE MODEL INSTALLATION

FIGURE 7

TABLE III

QEP FAN B TIP BLEED TESTS
TEST DATA ACCUMULATED ON SCALE MODEL

Run No.	25-A	25-B	26-B1	26-B2
Test Date	12/18/70	12/18/70	12/29/70	12/29/70
% Bleed	4%	0%	3%	2%
Fan Speed (RPM)	Reading Numbers			
4040	355 365	375 385	- -	- -
4474 (Approach)	356* 366	376* 386	424* 428	423* 427
4700	357 367	377 387	- -	- -
4907	358* 368	378* 388	- -	- -
5505	359 369	379 389	- -	- -
5990	360* 370	380* 390	- -	- -
6354	361 371	381 391	- -	- -
6526	362 372	382 392	- -	- -
6649	363 373	383 393	- -	- -
6845 (Takeoff)	364 374*	384* 394	426* 430	425* 429

*One hundred foot, 1/3 octave data are presented in the Appendix.

VI. Test Data Analysis

A. Noise and Boundary Layer Thickness

Farfield acoustic data were taken at several angles along with boundary layer thickness measurements for various bleed rates during aerodynamic test runs. These data were used to select the bleed rates on which full sets of acoustic data would be taken.

The boundary layer thickness was measured by an inlet boundary layer rake which was located ½ inch (1.3 cm) upstream of the rotor leading edge, at the rear of the bleed slot. A detailed drawing of the rake, including an installation view, is presented in the Appendix, Figure 6A.

The boundary layer pressure profiles recorded for various bleed rates are shown in Figure 8. For takeoff, 3.8% was the highest bleed rate on which boundary layer data was taken. This did not quite remove the entire boundary layer. Later, system modifications raised the maximum takeoff bleed rate to 4.25%, although no boundary layer measurements were obtained at this rate. At approach speed, the 3.5% bleed rate effectively removed the entire boundary layer. At 5% bleed, almost no change beyond the results of the 3.5% bleed rate occurred.

From this information, it appeared that 4% was the limiting bleed rate to produce a favorable acoustic result for this bleed configuration. Thus, it was decided to take farfield data at this rate. Additional data were taken at zero bleed in order to establish a baseline and also at 2% and 3% bleed.

The boundary layer data also provided a means of correlating displacement and momentum thickness with noise generation. The displacement and momentum thickness

were calculated by classical methods. Static temperature, static pressure and total pressure measurements were used to determine the axial velocity at each immersion for each bleed rate. These velocities were numerically integrated with respect to radial distance from the wall to find the displacement and momentum thickness which were correlated with 200 foot (61.0 m) sideline perceived noise levels. The change in PNL with respect to the standard casing level (labeled "baseline") is shown in Figures 9 and 10 for a front angle 50 degrees. It is immediately obvious that the noise decreased with increasing bleed rate or as is shown, with decreasing momentum and displacement thickness. The lowest level, however, with bleed did not reach the standard casing level (labeled "baseline").

It is interesting to note, however, that the adverse boundary layer situation caused by the slot can nearly be cured by bleeding. It might then be possible to use bleeding of this type to reduce noise if the inlet boundary layer is separated or blow-in doors are being used as might be the case at high power settings and low flight speed.

It may also be speculated that this particular slot configuration was incompatible with the aerodynamics of the short bellmouth inlet used here and that some other bleeding arrangement might be successful. A less obstructive design might be a porous wall rather than a slot.

QEP SCALE MODEL FAN B
BOUNDARY LAYER PRESSURE PROFILES

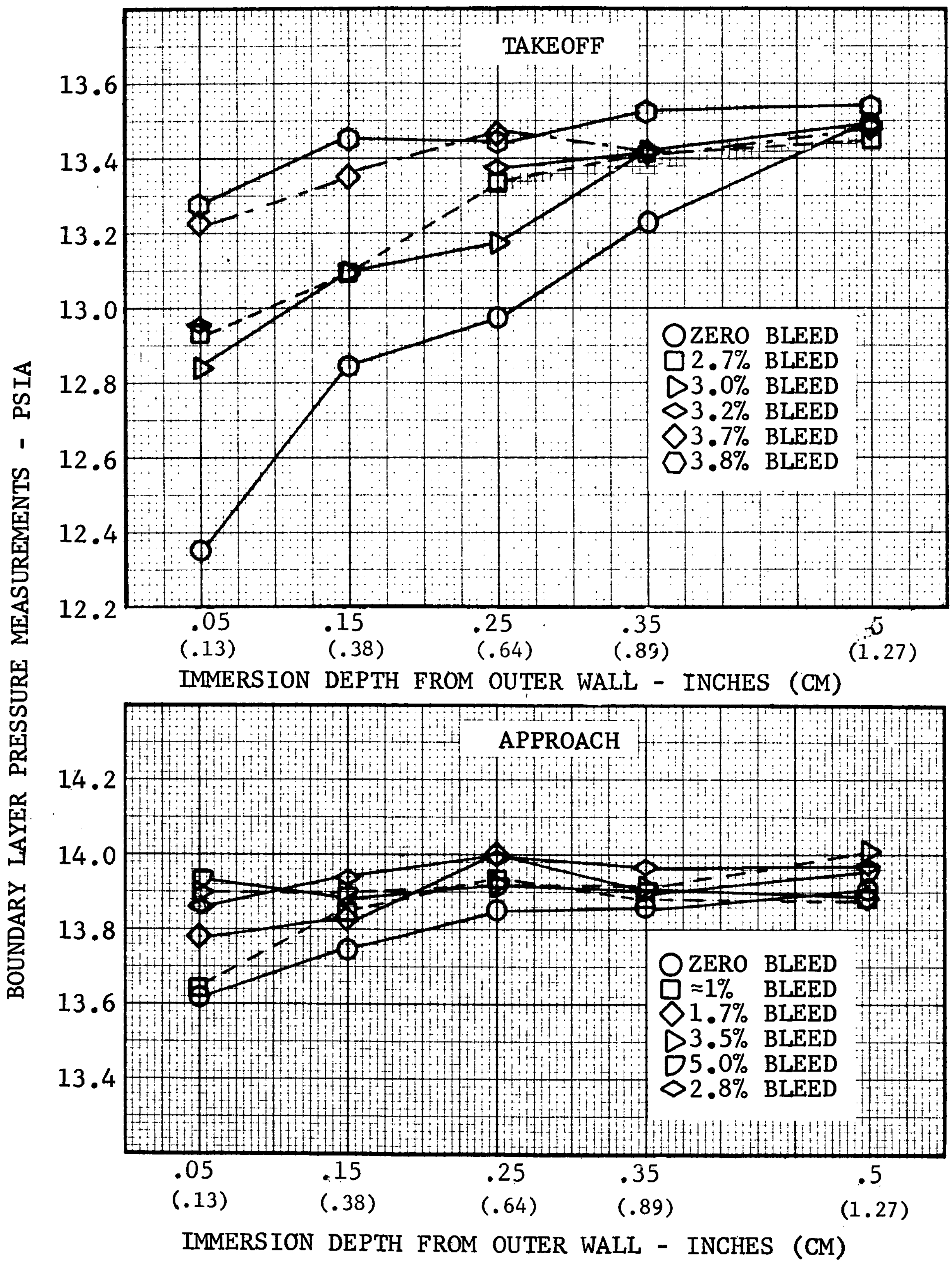


Figure 8

QEP SCALE MODEL FAN B TIP BLEED TEST RESULTS
200' SIDELINE PNL AT 50°
STANDARD DAY

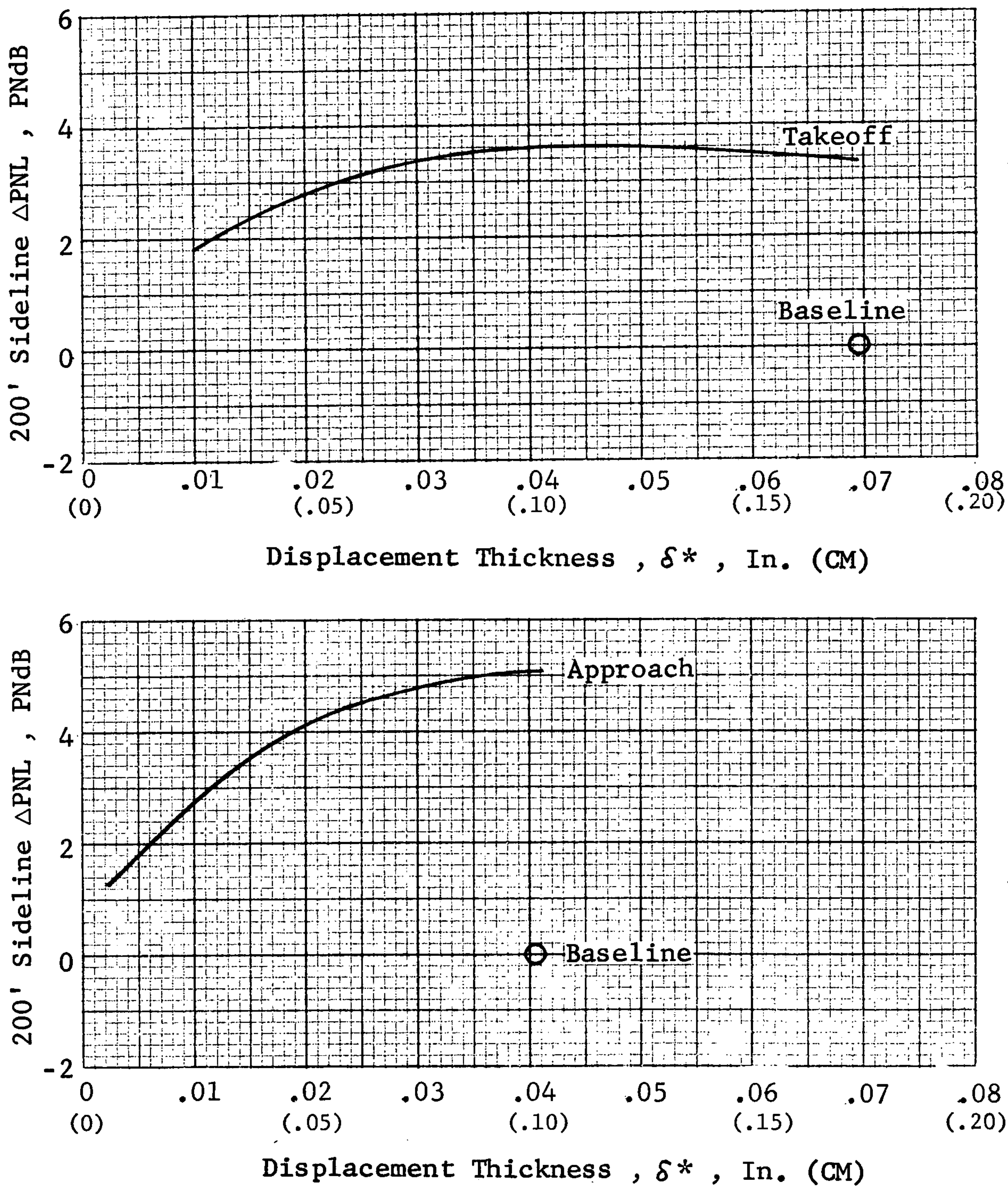


Figure 9

QEP SCALE MODEL FAN B TIP BLEED TEST RESULTS
200' SIDELINE PNL AT 50°
STANDARD DAY

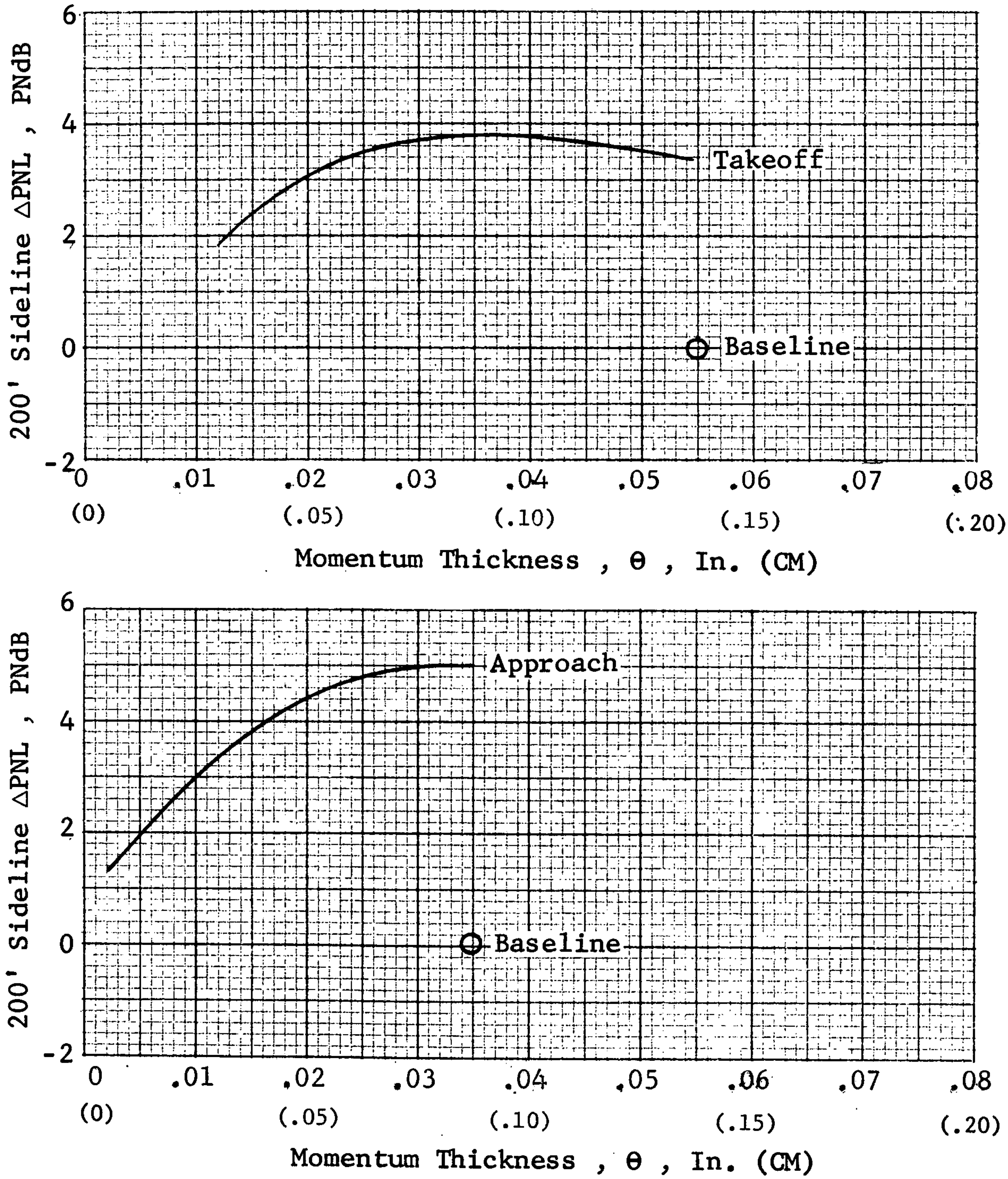


Figure 10

B. Bleed Test Results - Scale Model

Figures 11-30 present the noise characteristics resulting from bleed rates of 0%, 2%, 3% and 4% of the weight flow and include the characteristics of the treated fan without the bleed slot (standard casing) as a baseline. The data presented were recorded around a 100 foot (30.5 m) arc and have been corrected to Standard Day conditions of 59°F (15°C) temperature and 70% relative humidity.

Figures 11-18 show the distribution of the fundamental and the second harmonic around the arc at approach and takeoff thrust. The SPL's of the tones were derived from narrowband data and then corrected to Standard Day. The sound power levels were calculated from these arc SPL values with corrections for ground plane absorption.

The first two figures, which contain the fundamental tones at approach thrust, indicate a basic problem. At all farfield angles, the sound pressure levels of the standard casing configuration were lower than any of those levels attained with tip bleeding. The 0% bleed casing, i.e., the casing with the bleed slot but with zero bleed, showed an increase of the fundamental tone PWL of 6.0 dB over the standard casing. Figures 13 and 14 show that a similar situation existed for the second harmonic; however, the distribution around the arc was not as consistent and the difference between the standard casing and the bleed casing configurations was smaller (4.6 dB PWL for 0% bleed casing). This disparity was reduced for both tones by bleeding; nevertheless, at approach thrust, the tone power levels of the fan without the bleed slot were not achieved by any bleed rate attainable with this tip bleed configuration.

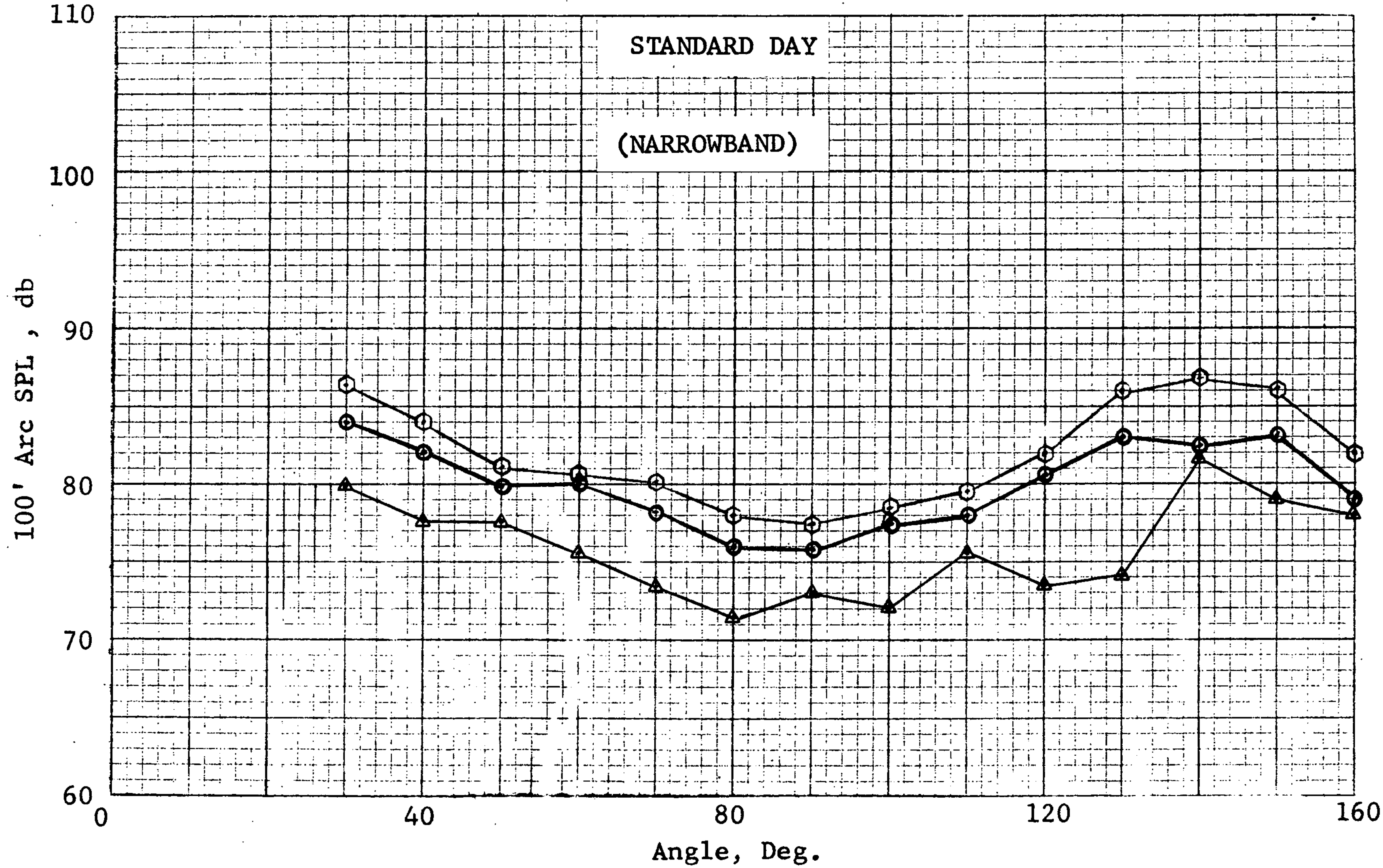
The distribution of the blade passing frequency at takeoff thrust, shown by Figures 15 and 16, indicate some tone level reduction in the front quadrant, even for the 0% bleed casing. The sound power levels were slightly down for all bleed rates with the 4% rate resulting in the lowest PWL, 2 dB below that for the standard casing. Figures 17 and 18 show the second harmonic tone directivities for takeoff. As with the second harmonic at approach thrust, the bleed casing increased the PWL above that of the standard casing. Likewise, the 4% bleed rate produced the smallest delta observed for this thrust and configuration.

Figures 19-22 present the 1/3 octave spectra at 50° and 130° for approach thrust. (The 1/3 octave scale model data is presented in the Appendix, Section VIII, for approach and takeoff thrust at all angles). The side bands around the tones largely reflect the trend of the tones themselves, i.e., the baseline results were lower than those from the bleed casing and the bleed casing noise levels decreased with increasing bleed rates.

The 1/3 octave spectra for takeoff thrust are presented for 50° and 130° in Figures 23-26. The figures clearly indicate that the standard casing configuration produced the least noise, with the exception of the blade passing frequency at 50°. The 4% spectra were the quietest of the four bleed rates investigated while the 0%, 2% and 3% bleed rates produced generally the same noise levels.

Figures 27 and 28 contain the sound power level spectra for approach thrust. The data clearly show that the treated baseline was lower than the tip bleed configuration across the spectrum. The power levels were generally the same at frequencies below the fundamental for the four bleed rates while the power levels at the tones decreased with increasing bleed rates. From 6300-10K Hz, the 0%, 2% and 3% bleed rates were approximately 2 dB PWL higher than the 4% rate. The PWL spectra for takeoff thrust (Figures 29-30) indicate a similar situation with the exception that at the fundamental frequency, the power levels of the baseline and the four bleed rates were about equal.

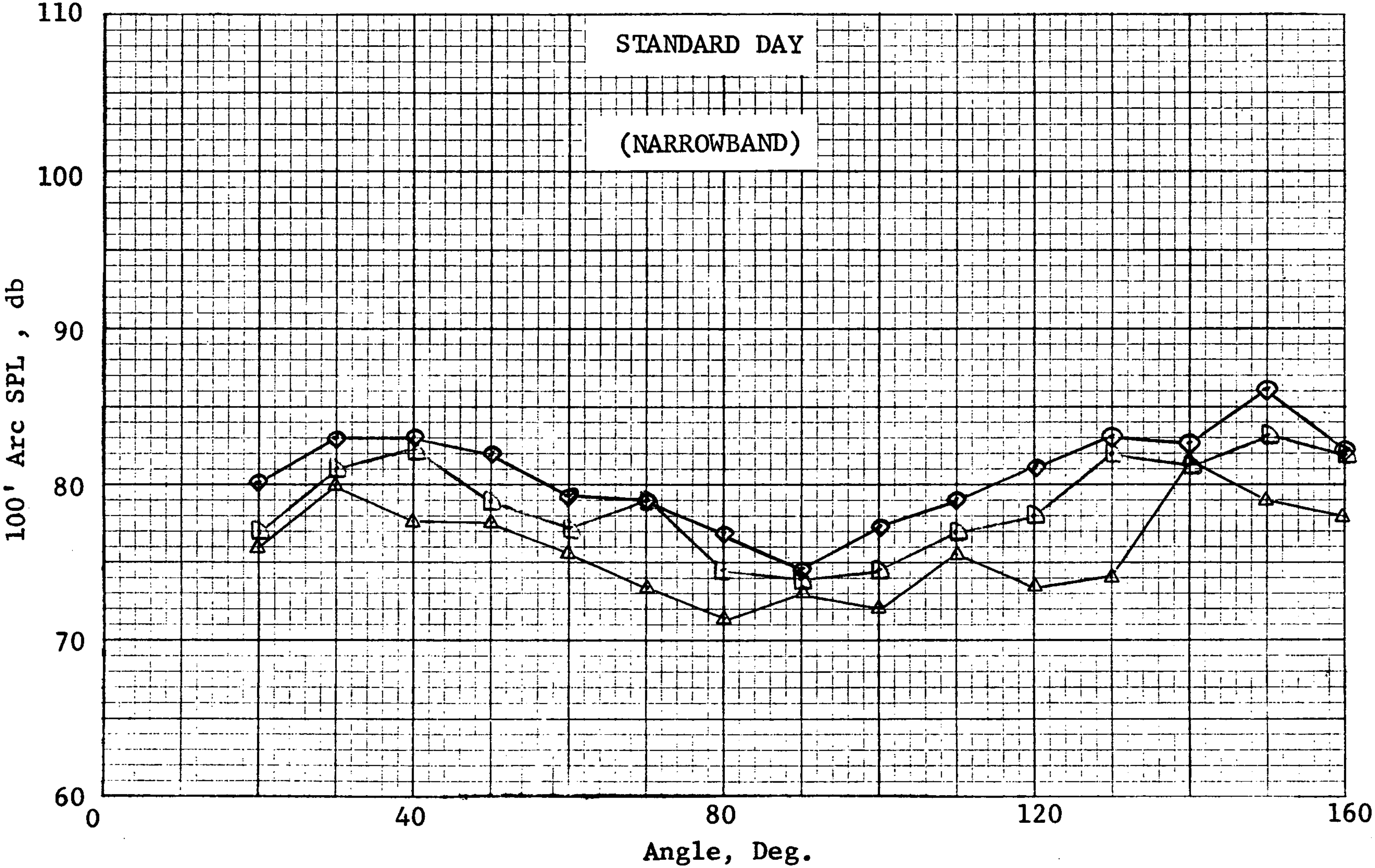
FAN B SCALE MODEL - FARFIELD DATA
FUNDAMENTAL - APPROACH



△ STANDARD CASING - PWL = 127.0
⬡ 0% BLEED - PWL = 133.0
○ 4% BLEED - PWL = 130.8

Figure 11

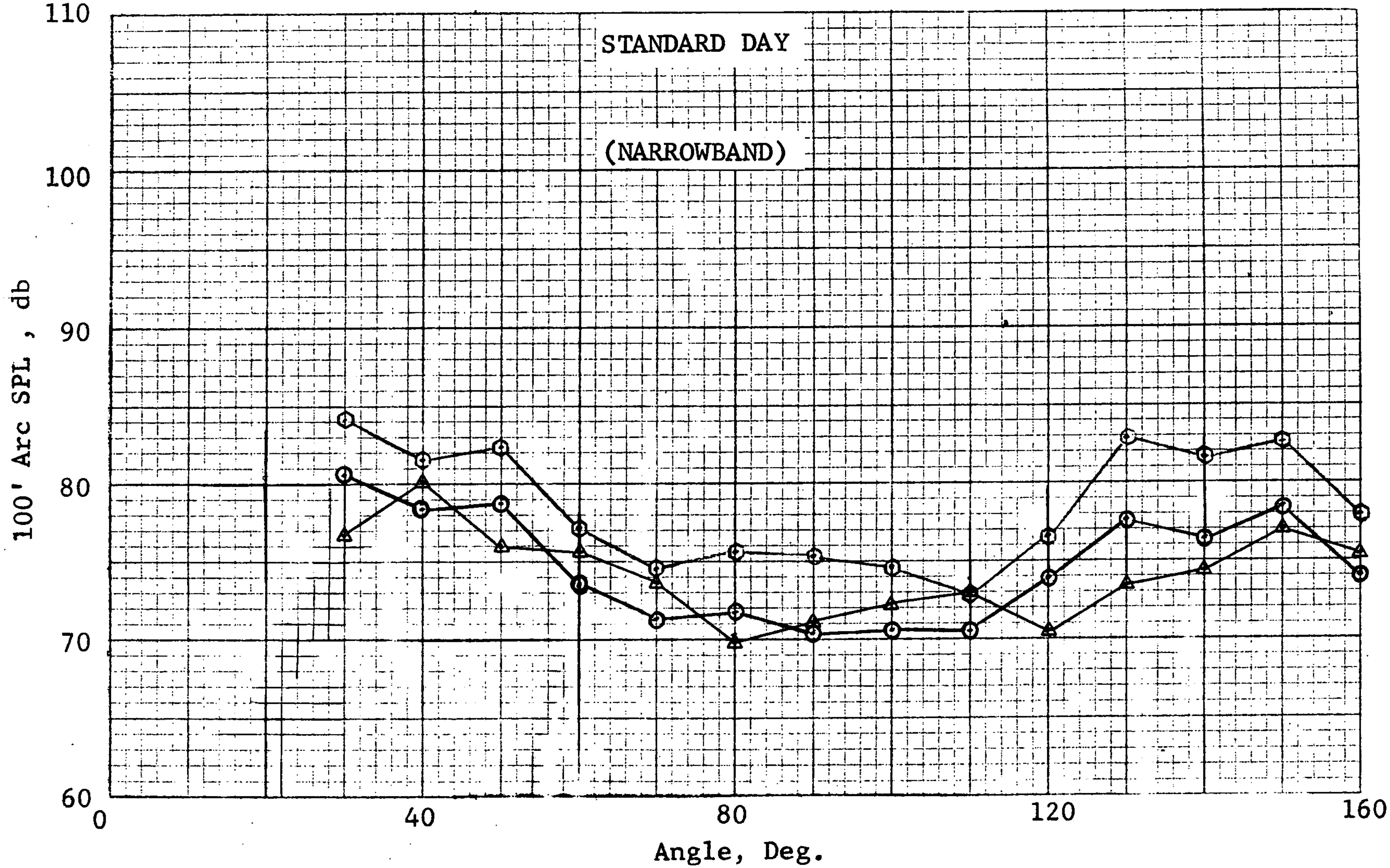
FAN B SCALE MODEL - FARFIELD DATA
FUNDAMENTAL - APPROACH



△ STANDARD CASING - PWL = 127.0
◇ 2% BLEED - PWL = 131.4
D 3% BLEED - PWL = 130.0

Figure 12

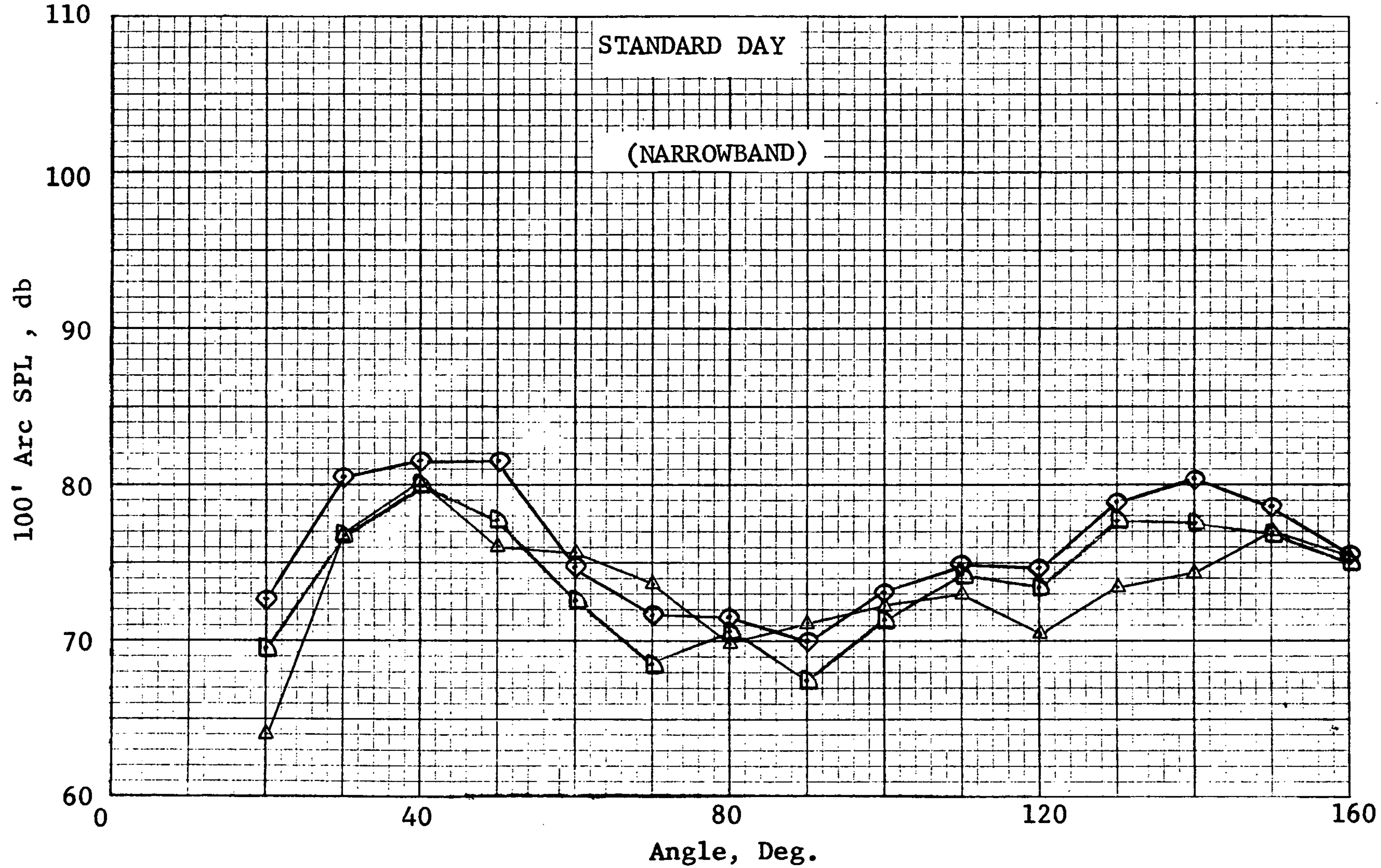
FAN B SCALE MODEL - FARFIELD DATA
2ND HARMONIC - APPROACH



△ STANDARD CASING - PWL = 125.8
⬡ 0% BLEED - PWL = 130.4
○ 4% BLEED - PWL = 126.4

Figure 13

FAN B SCALE MODEL - FARFIELD DATA
2ND HARMONIC - APPROACH



△ STANDARD CASING - PWL = 125.8
◇ 2% BLEED - PWL = 128.5
D 3% BLEED - PWL = 126.4

Figure 14

FAN B SCALE MODEL - FARFIELD DATA
FUNDAMENTAL - TAKEOFF

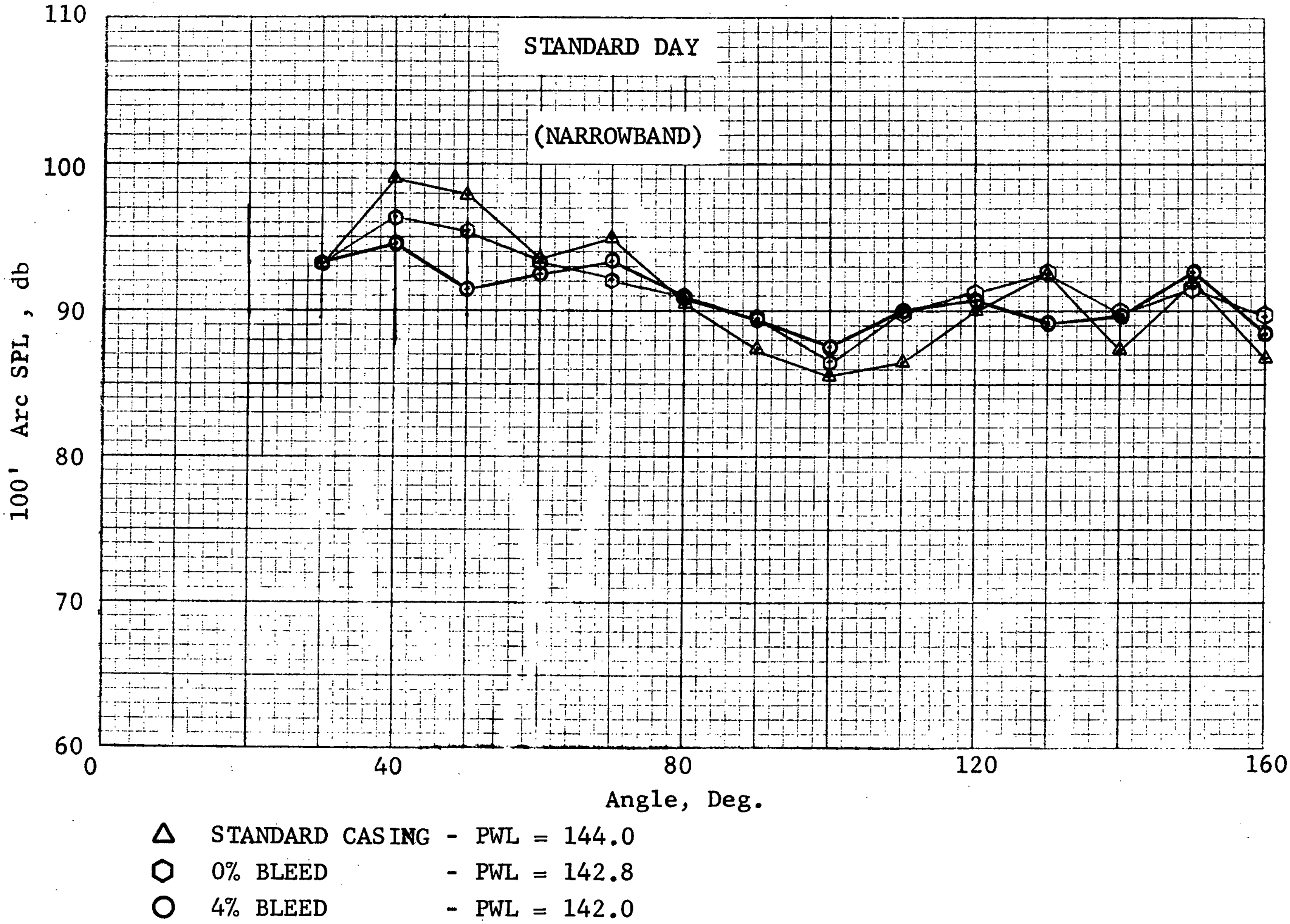
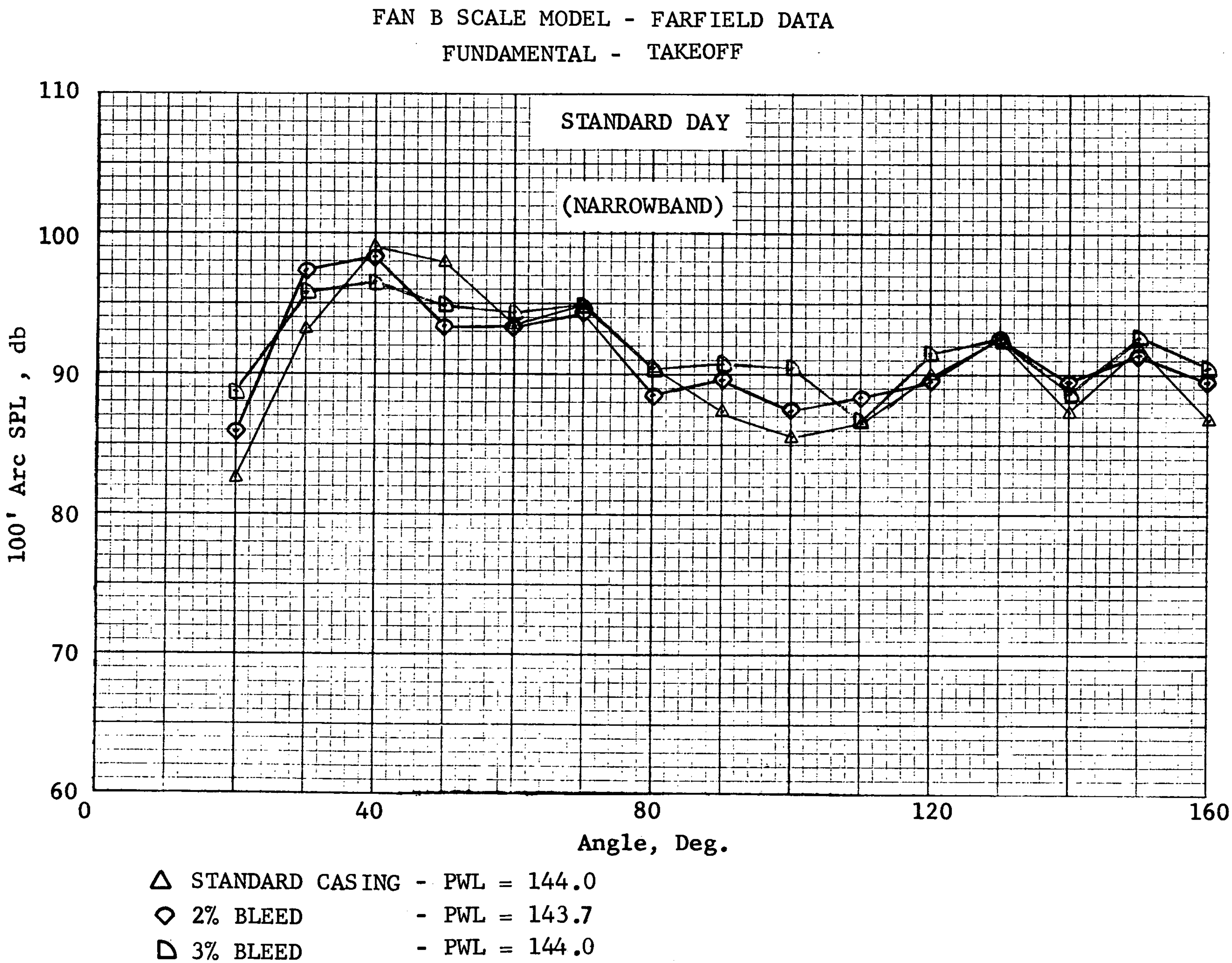


Figure 15



FAN B SCALE MODEL - FARFIELD DATA
FUNDAMENTAL - TAKEOFF
STANDARD DAY
(NARROWBAND)
110
100
90
80
70
60
100' Arc SPL , db
0
40
80
120
160
Angle, Deg.
△ STANDARD CASING - PWL = 144.0
◇ 2% BLEED - PWL = 143.7
D 3% BLEED - PWL = 144.0

Figure 16

FAN B SCALE MODEL - FARFIELD DATA

2ND HARMONIC - TAKEOFF

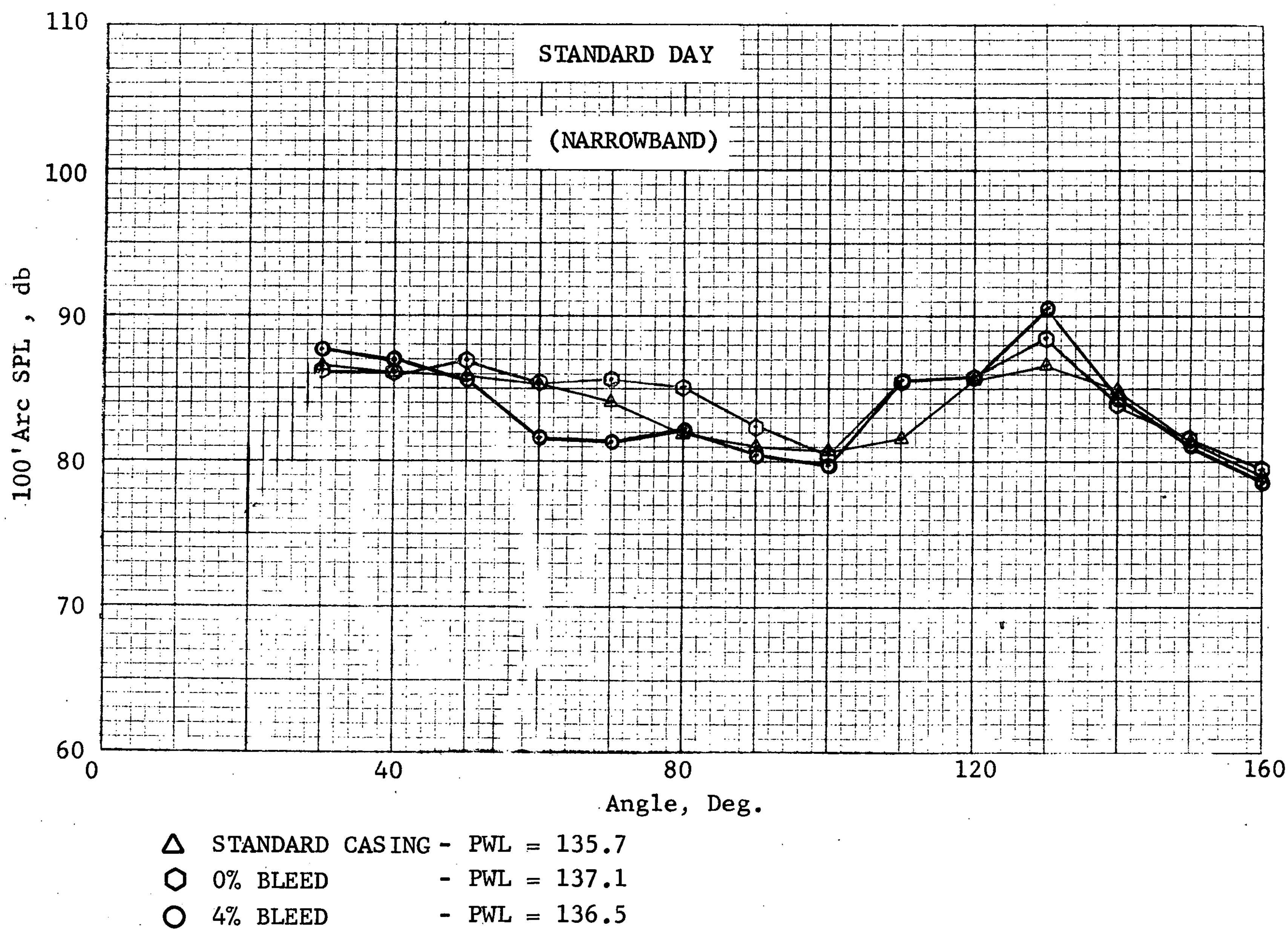
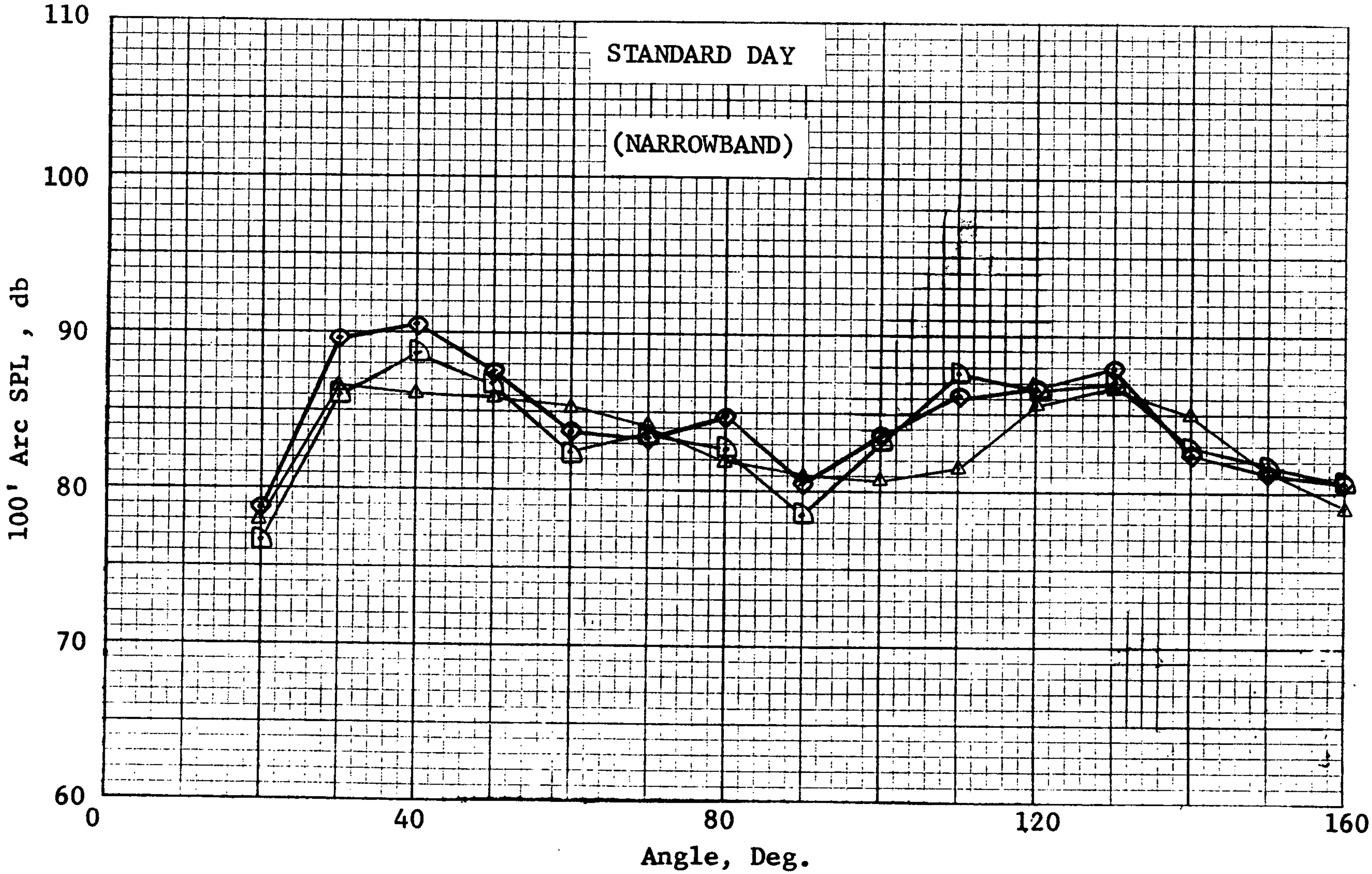


Figure 17

FAN B SCALE MODEL - FARFIELD DATA

2ND HARMONIC - TAKEOFF



△ STANDARD CASING - PWL = 135.7

◇ 2% BLEED - PWL = 138.2

D 3% BLEED - PWL = 137.5

Figure 18

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

APPROACH

50°

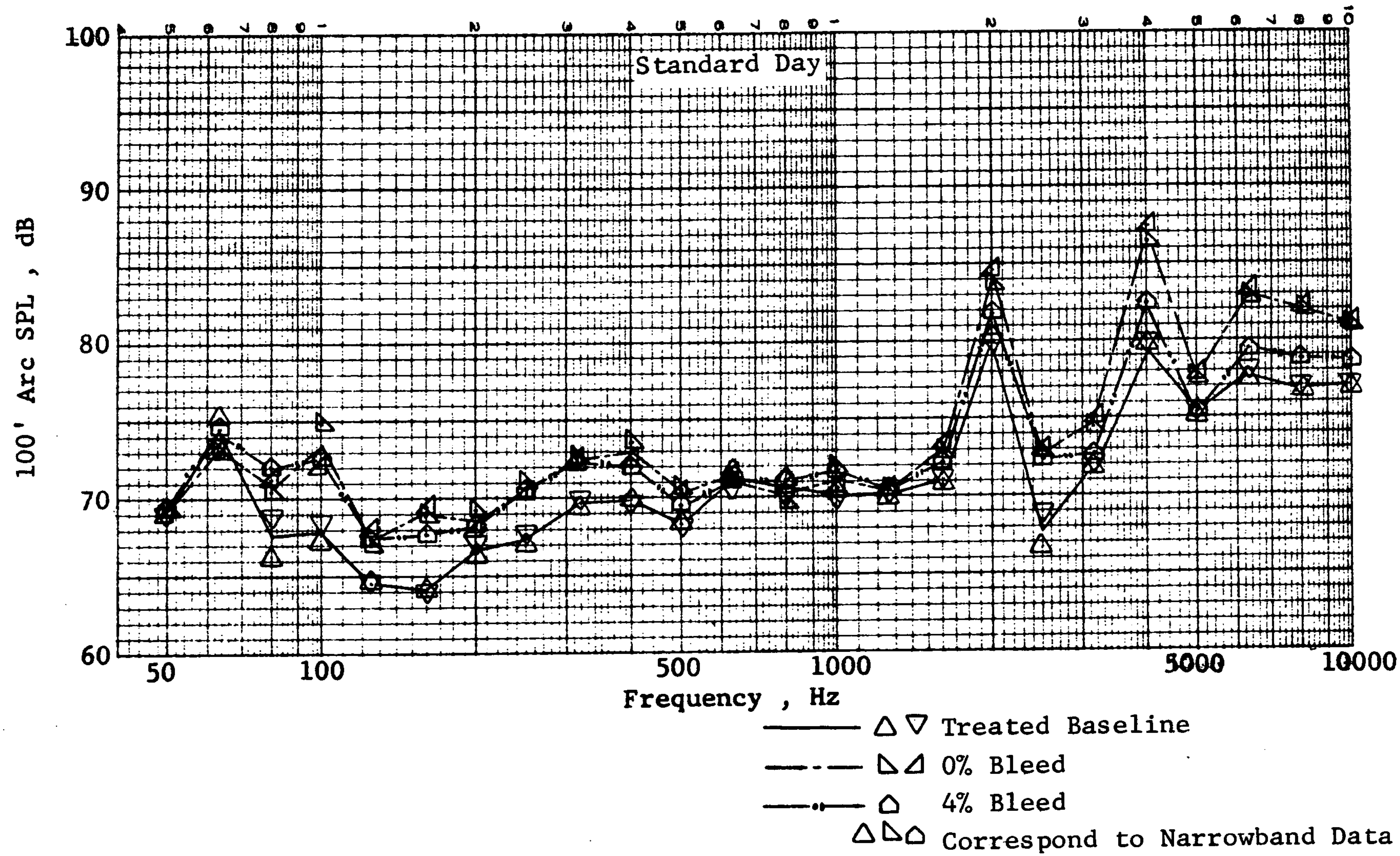


Figure 19

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

APPROACH

50°

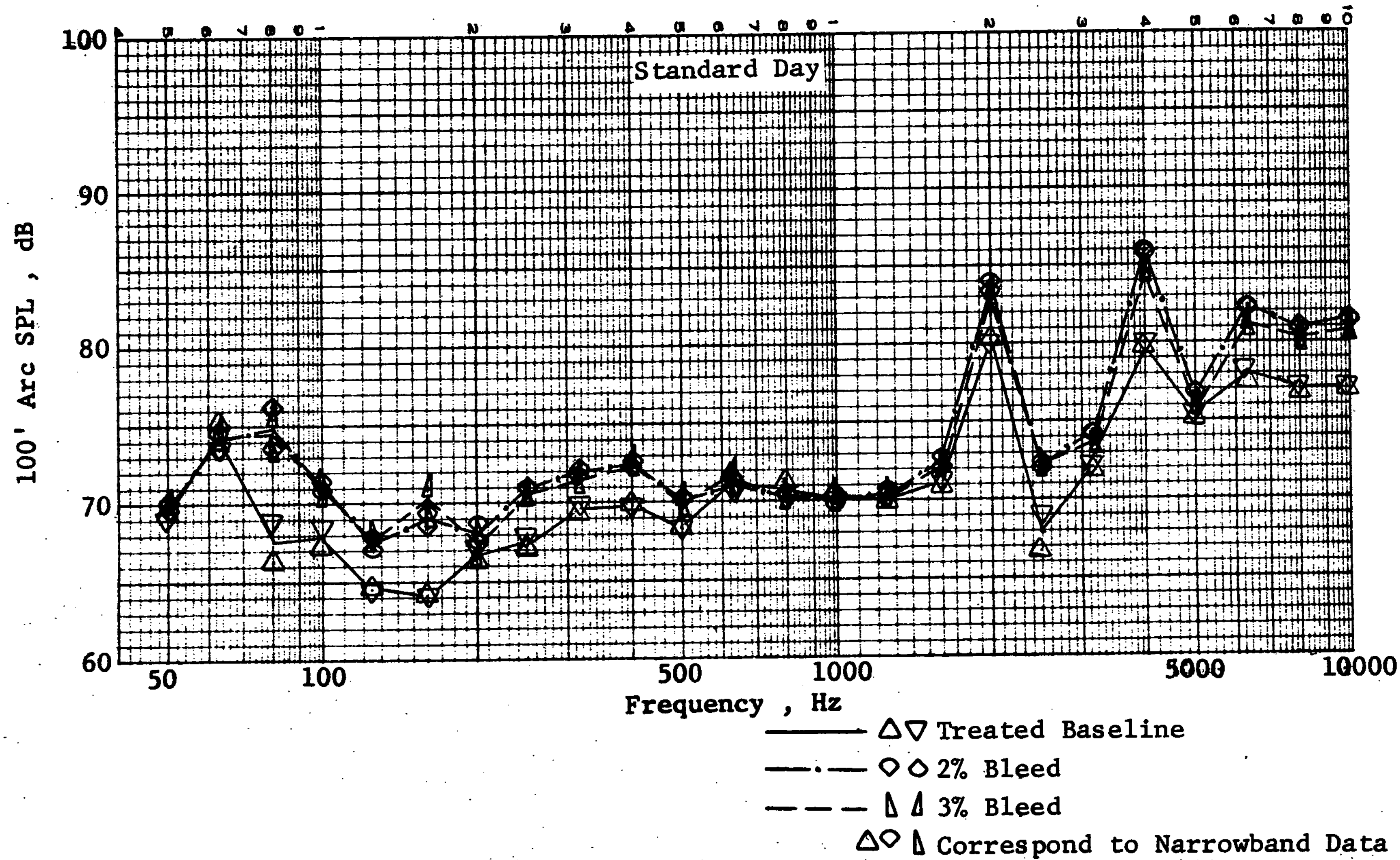


Figure 20

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

APPROACH

130°

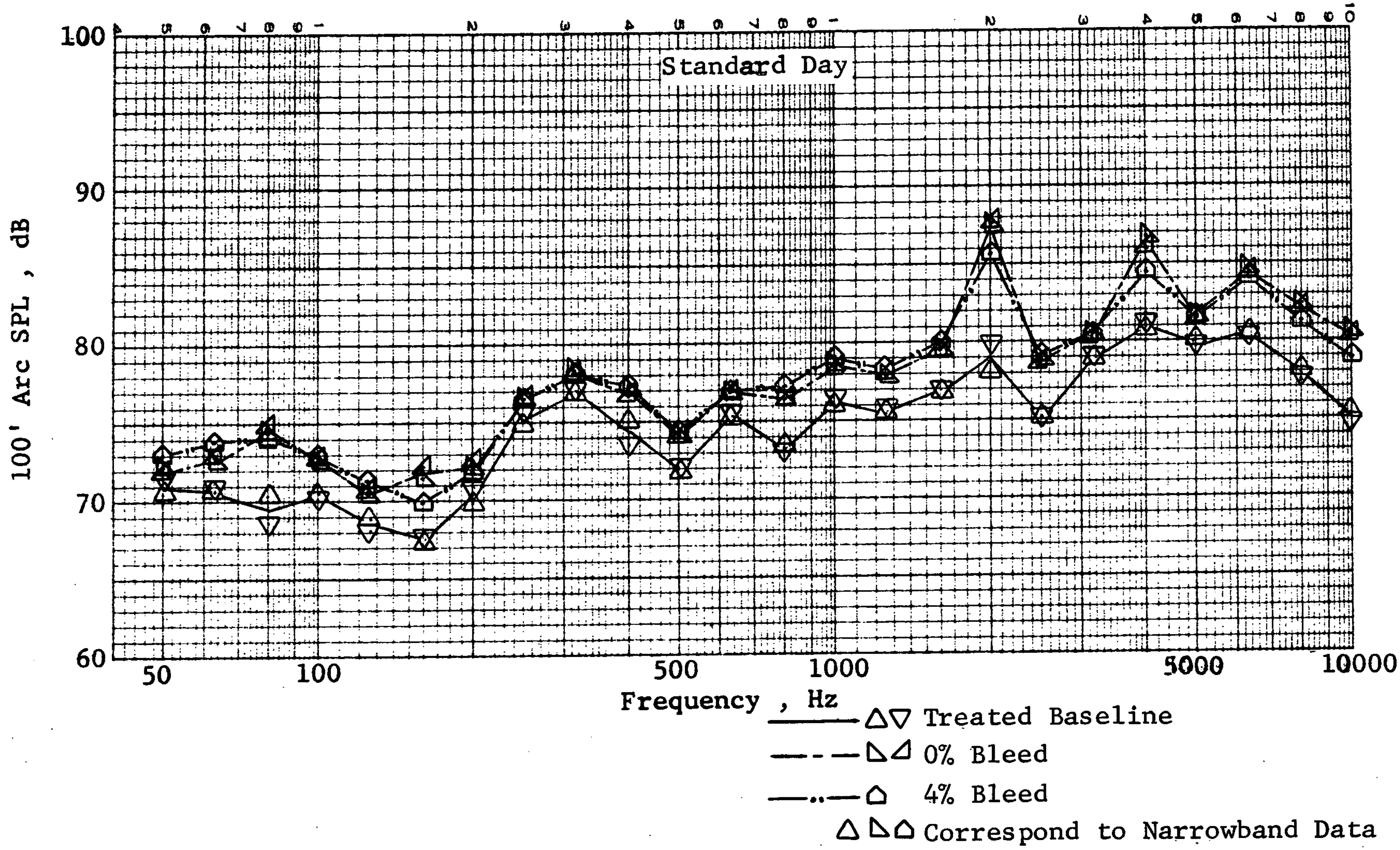


Figure 21

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

APPROACH

130°

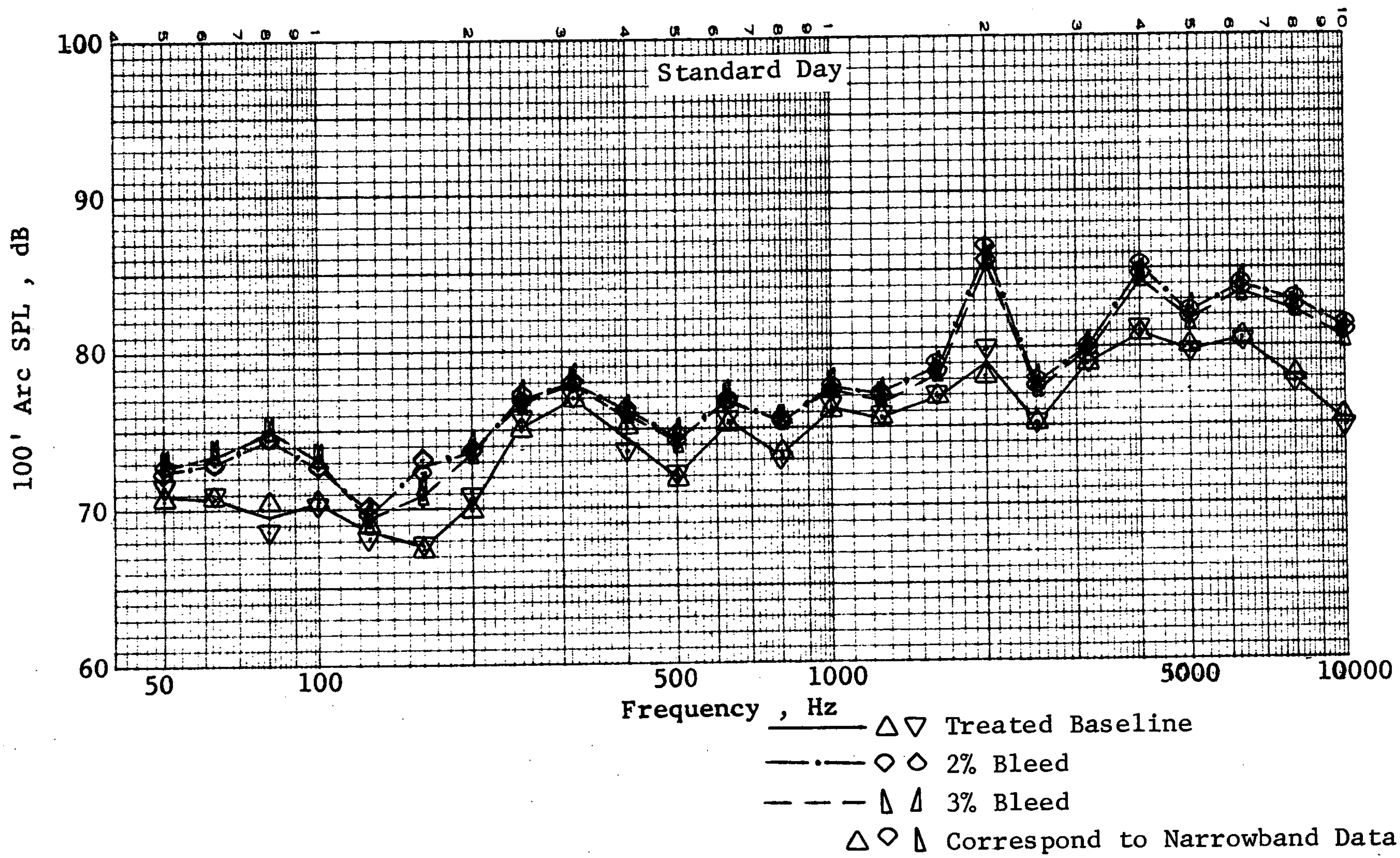


Figure 22

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

TAKEOFF

50°

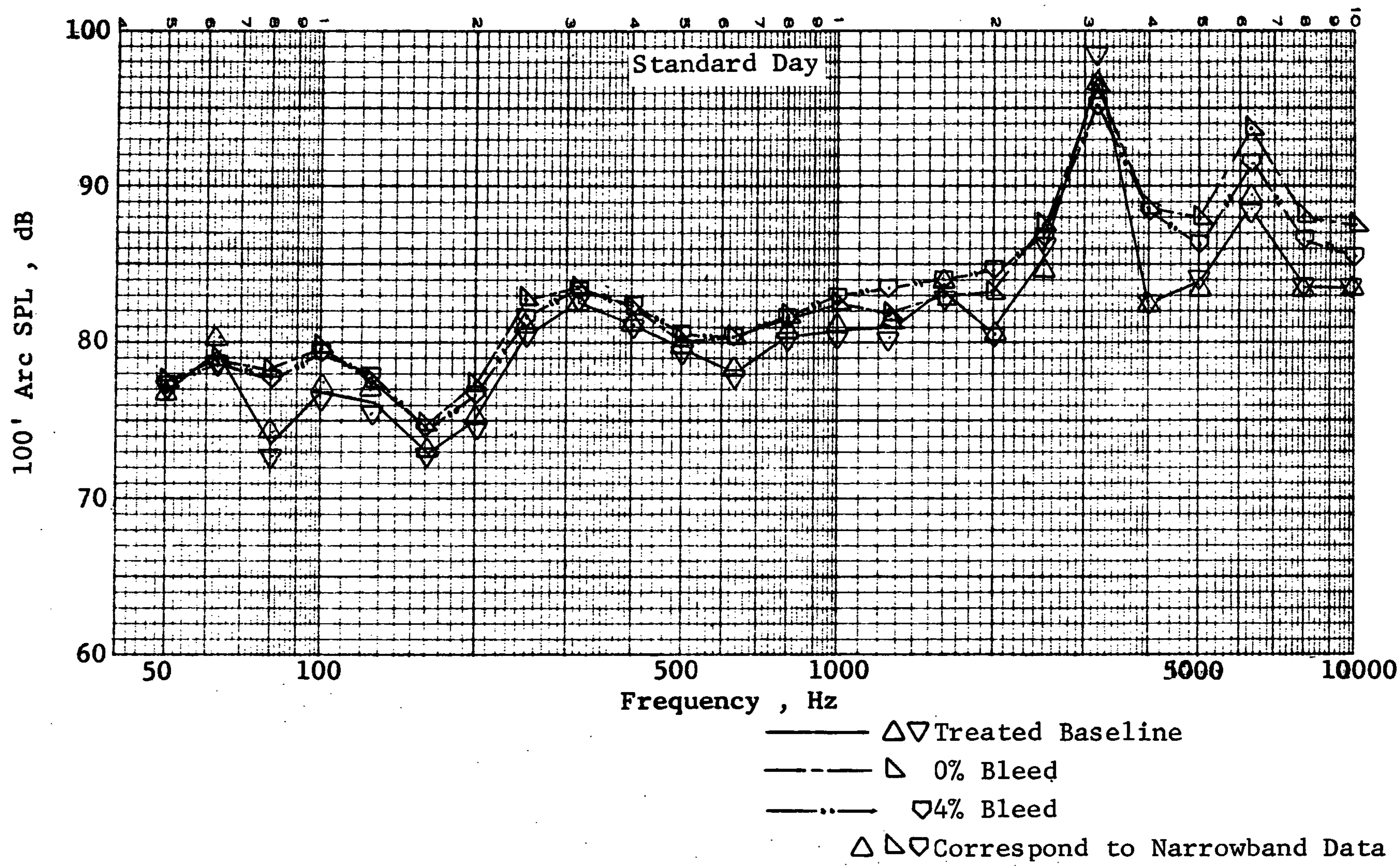


Figure 23

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

TAKEOFF

50°

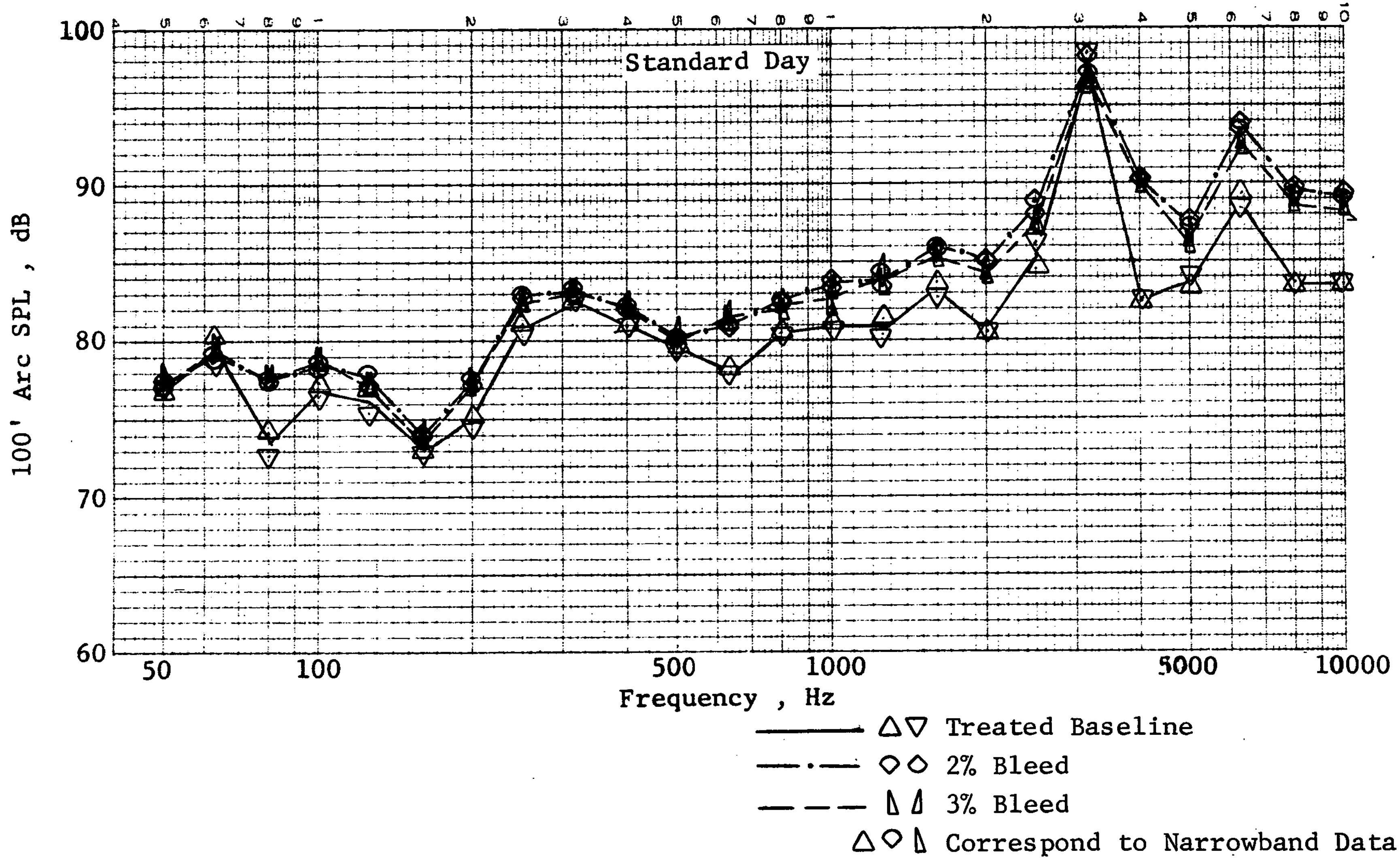


Figure 24

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

TAKEOFF

130°

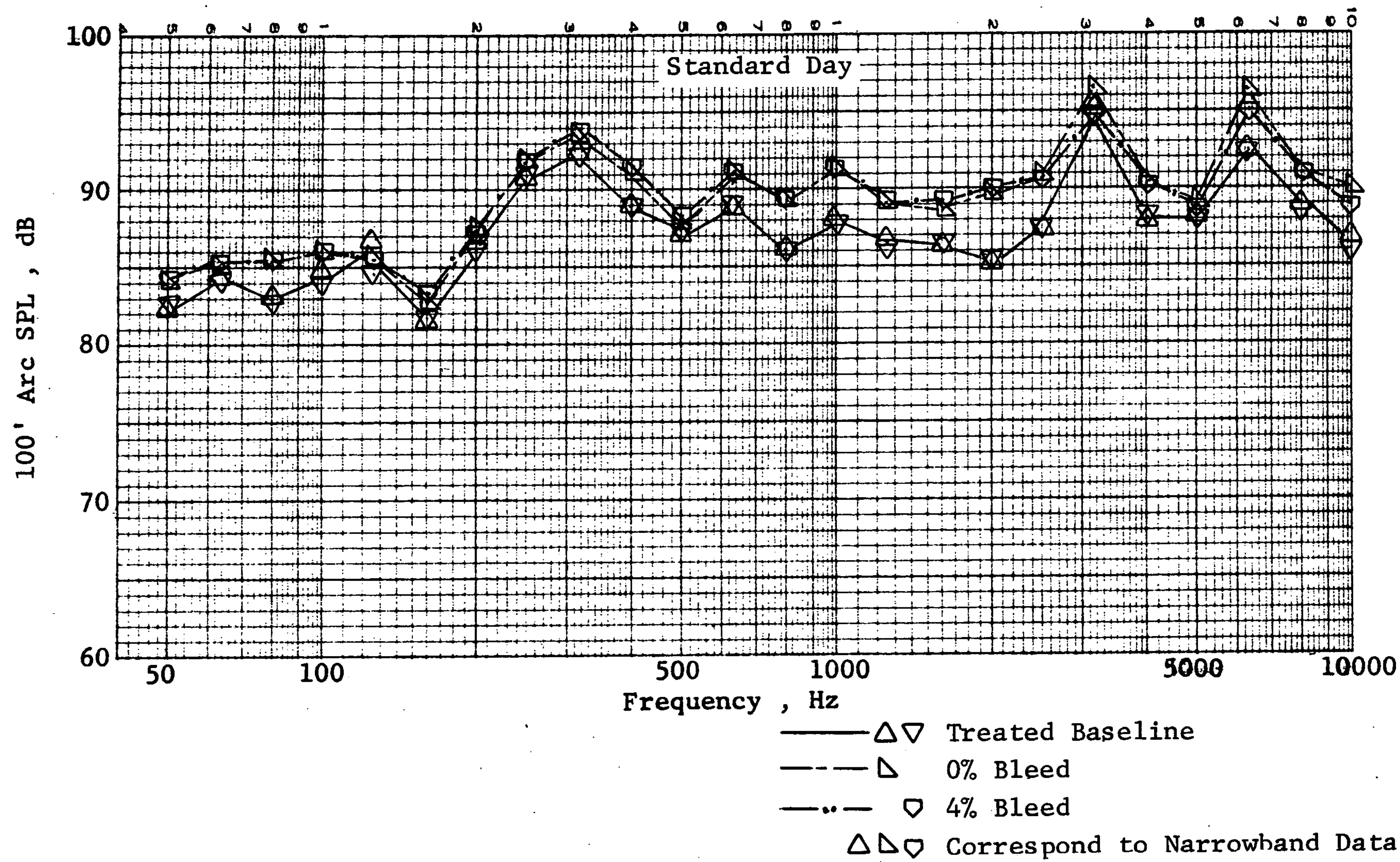


Figure 25

QEP FAN B

SCALE MODEL RESULTS

100' ARC SPL

TAKEOFF

130°

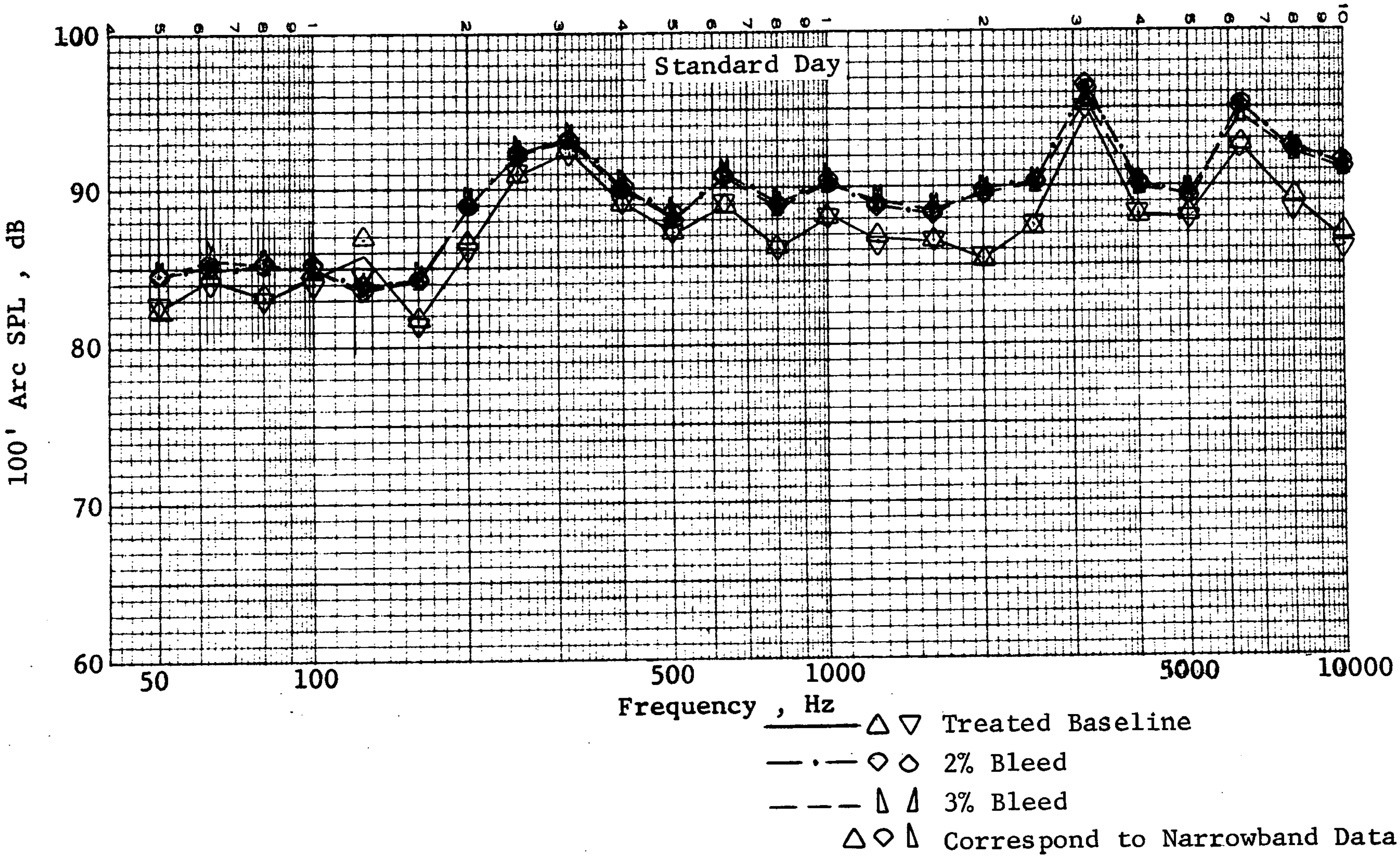


Figure 26

QEP FAN B SCALE MODEL TIP BLEED TEST RESULTS

SOUND POWER LEVELS AT APPROACH

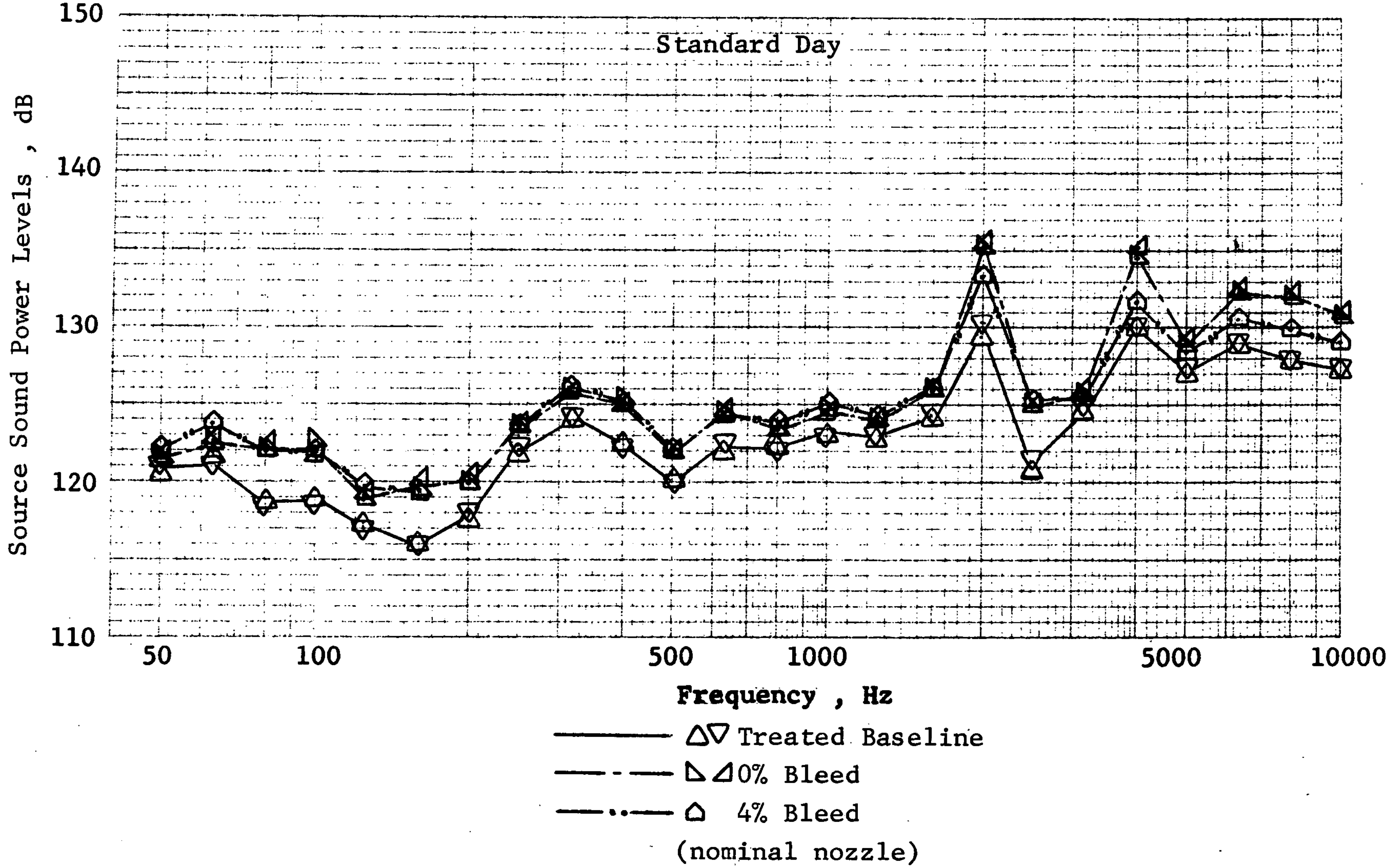


Figure 27

QEP FAN B SCALE MODEL TIP BLEED TEST RESULTS
SOUND POWER LEVELS AT APPROACH

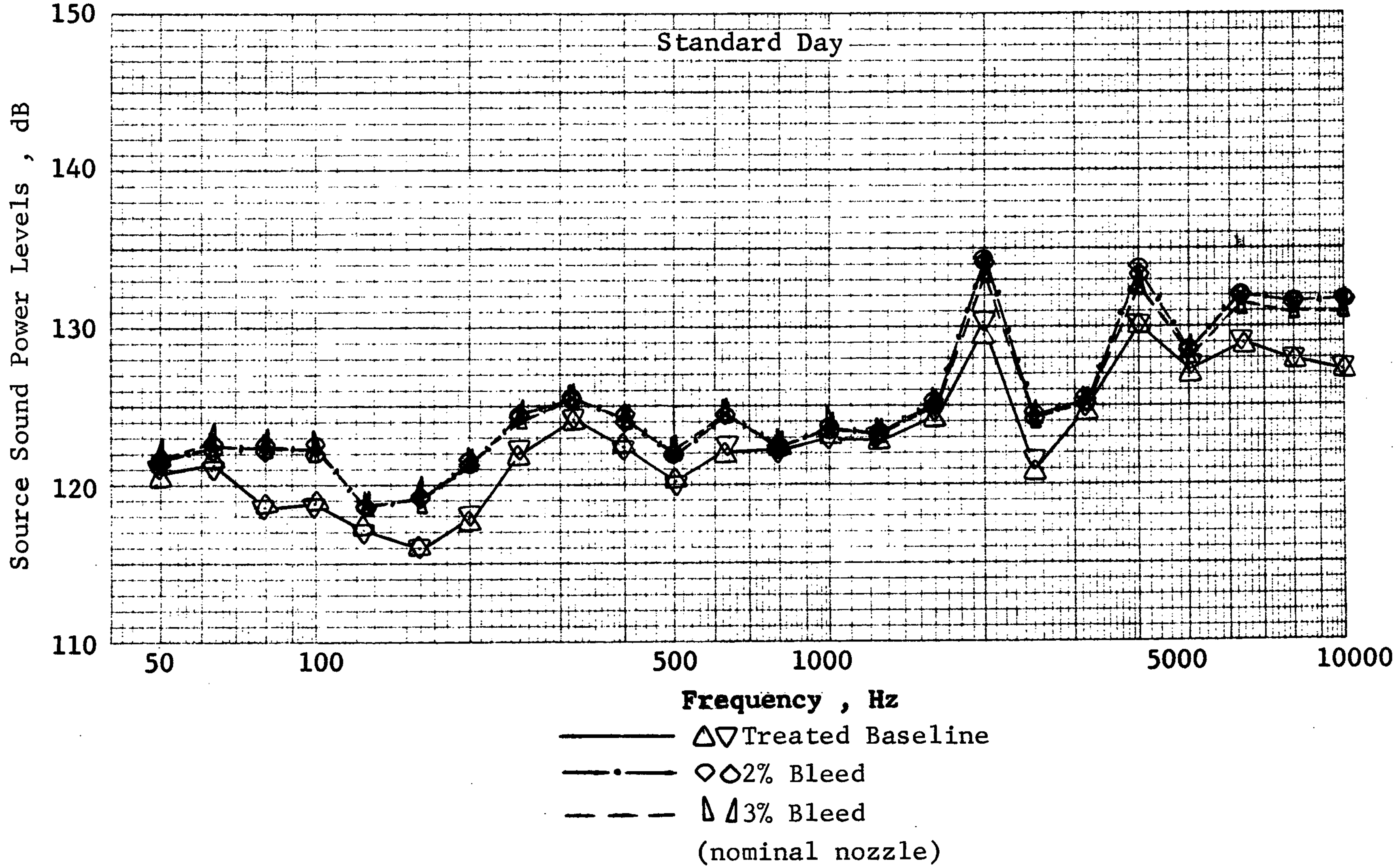


Figure 28

QEP FAN B SCALE MODEL TIP BLEED TEST RESULTS

SOUND POWER LEVELS AT TAKEOFF

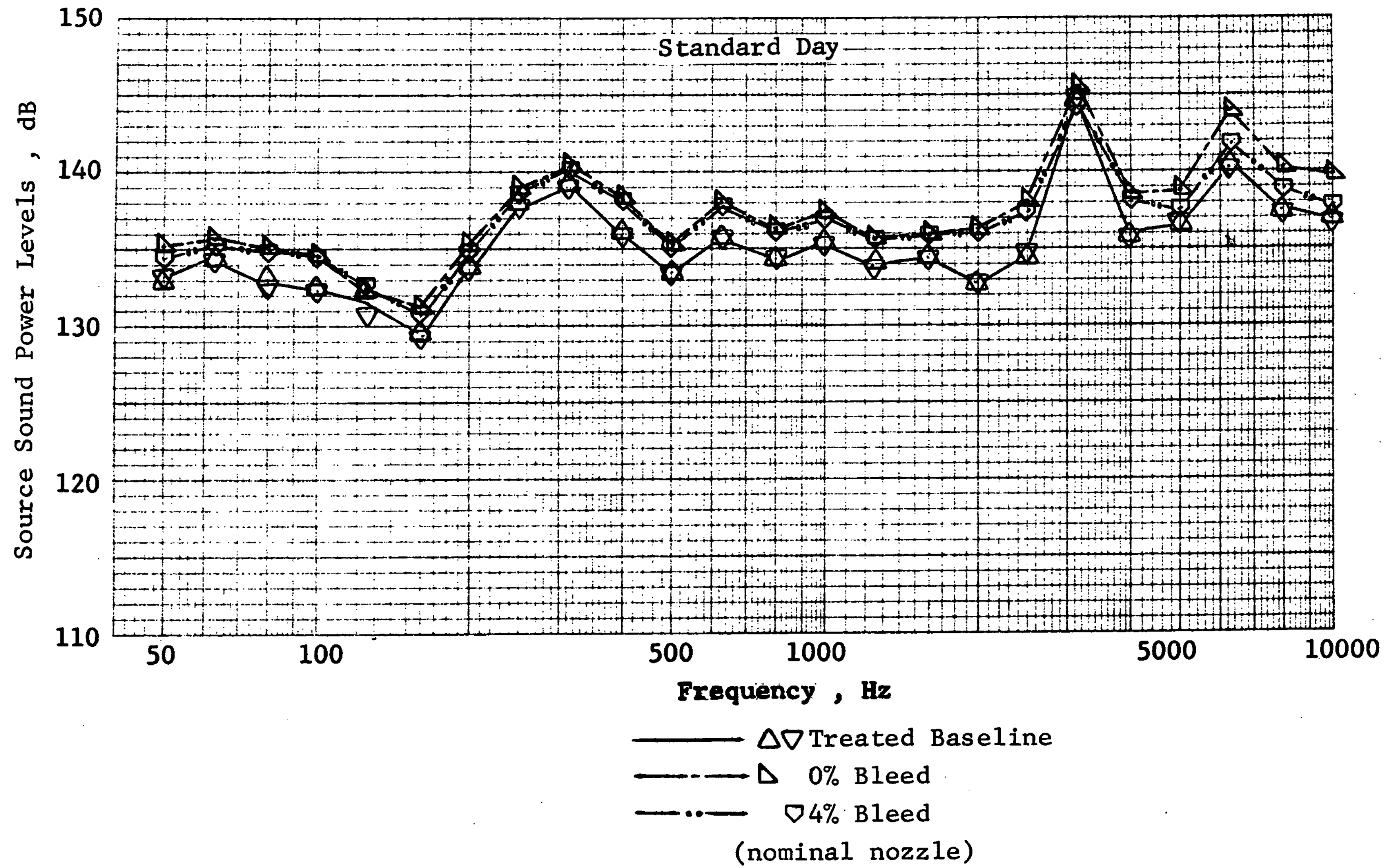


Figure 29

QEP FAN B SCALE MODEL TIP BLEED TEST RESULTS
SOUND POWER LEVELS AT TAKEOFF

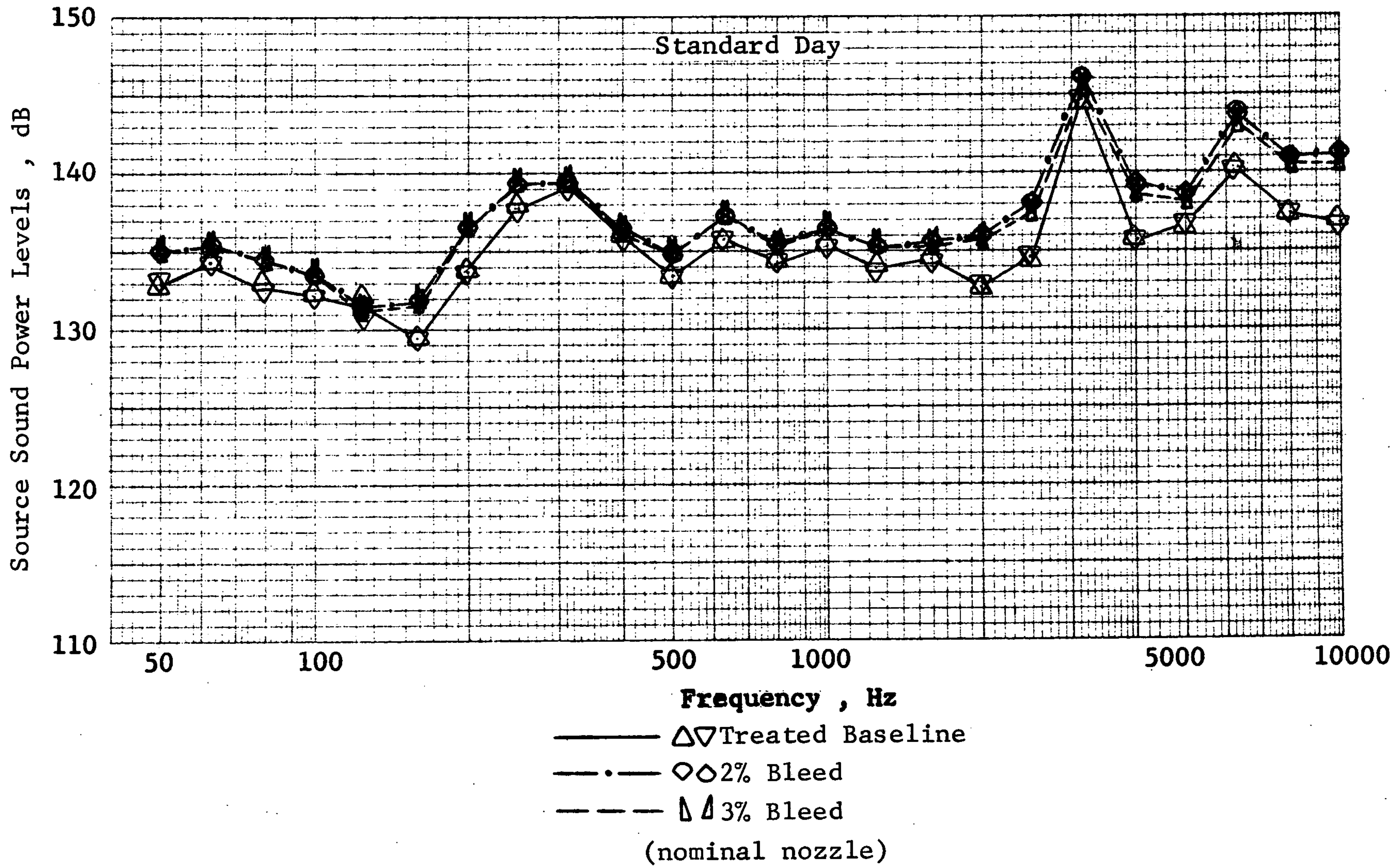


Figure 30

C. Bleed Test Results - Scaled Up To Full Scale

In order to obtain a picture of the full scale results, the scale model data was scaled up to full scale. Figures 31-34 present the 200 foot (61.0 m) sideline perceived noise levels at both approach and takeoff thrust for the treated baseline (standard casing) and for each of the bleed rates investigated. The baseline was lower than any of the bleed casing noise levels. At approach thrust, the 4% bleed results show a reduction in front end noise relative to the 0% bleed case while the 2% and 3% bleed rates produce approximately the same perceived noise. The same situation was found at takeoff thrust, although the 4% front end reduction was slight.

Figures 35 and 36 show the variation of the 200 foot (61.0 m) sideline maximum PWL with corrected speed. The bleed data was generally above the baseline, however, at about 2975 rpm, the 4% bleed results decreased to approximately the same level as the baseline.

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS BLEED TESTS

200' SIDELINE PNL

APPROACH - SINGLE FAN

STANDARD DAY

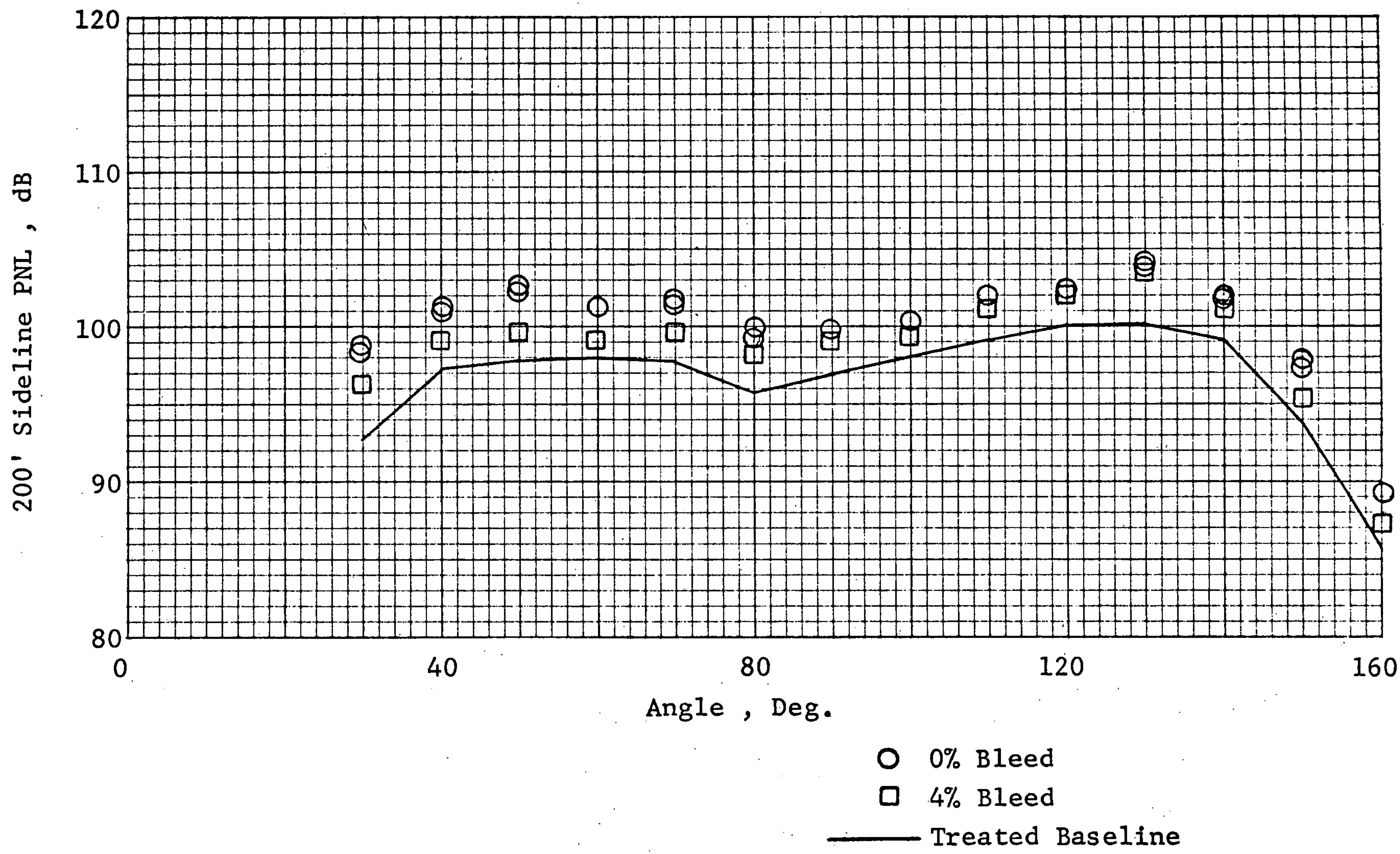


Figure 31

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL BLEED TEST RESULTS

200' SIDELINE PNL

APPROACH - SINGLE FAN

STANDARD DAY

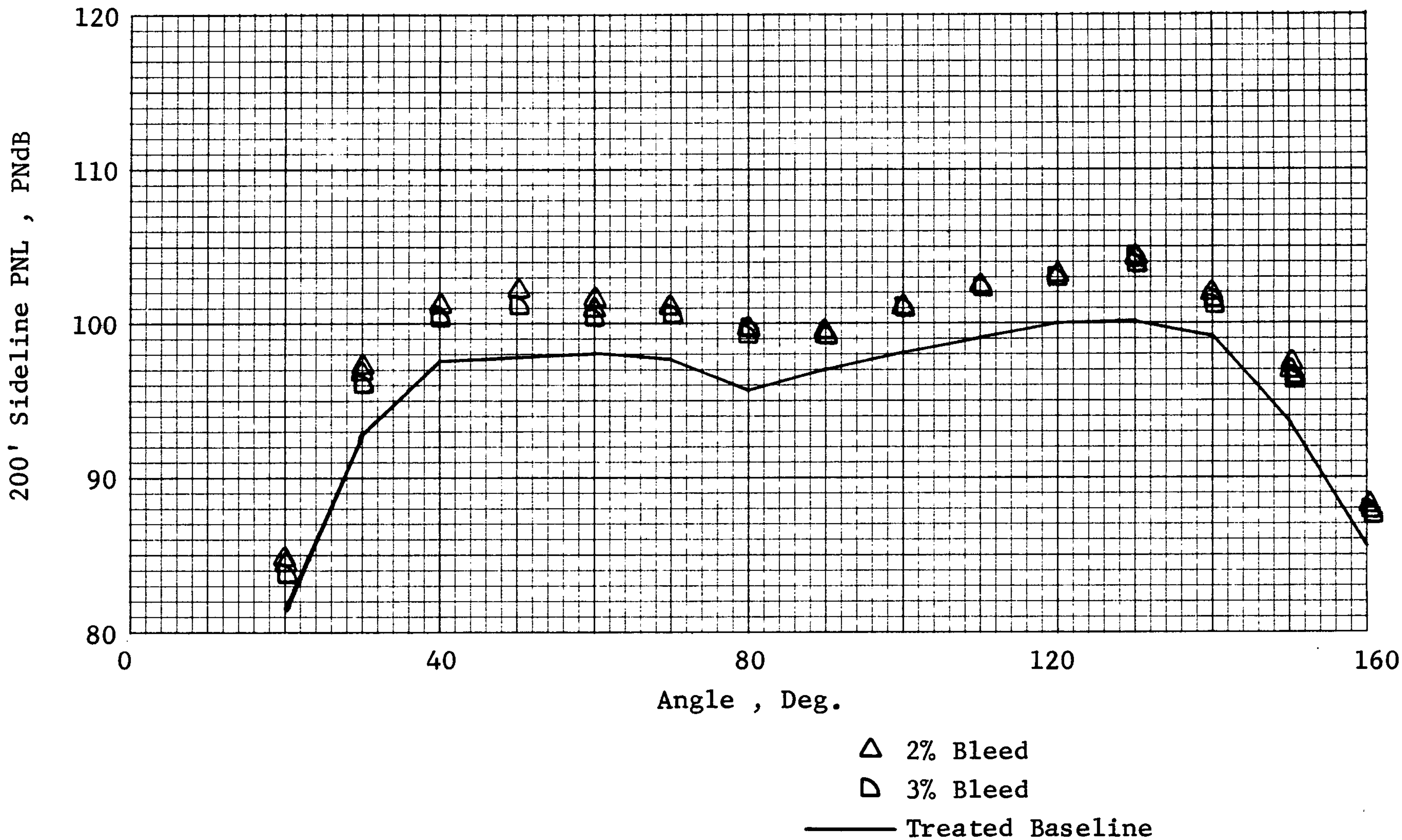


Figure 32

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL RESULTS BLEED TESTS

200' SIDELINE PNL

TAKEOFF - SINGLE FAN

STANDARD DAY

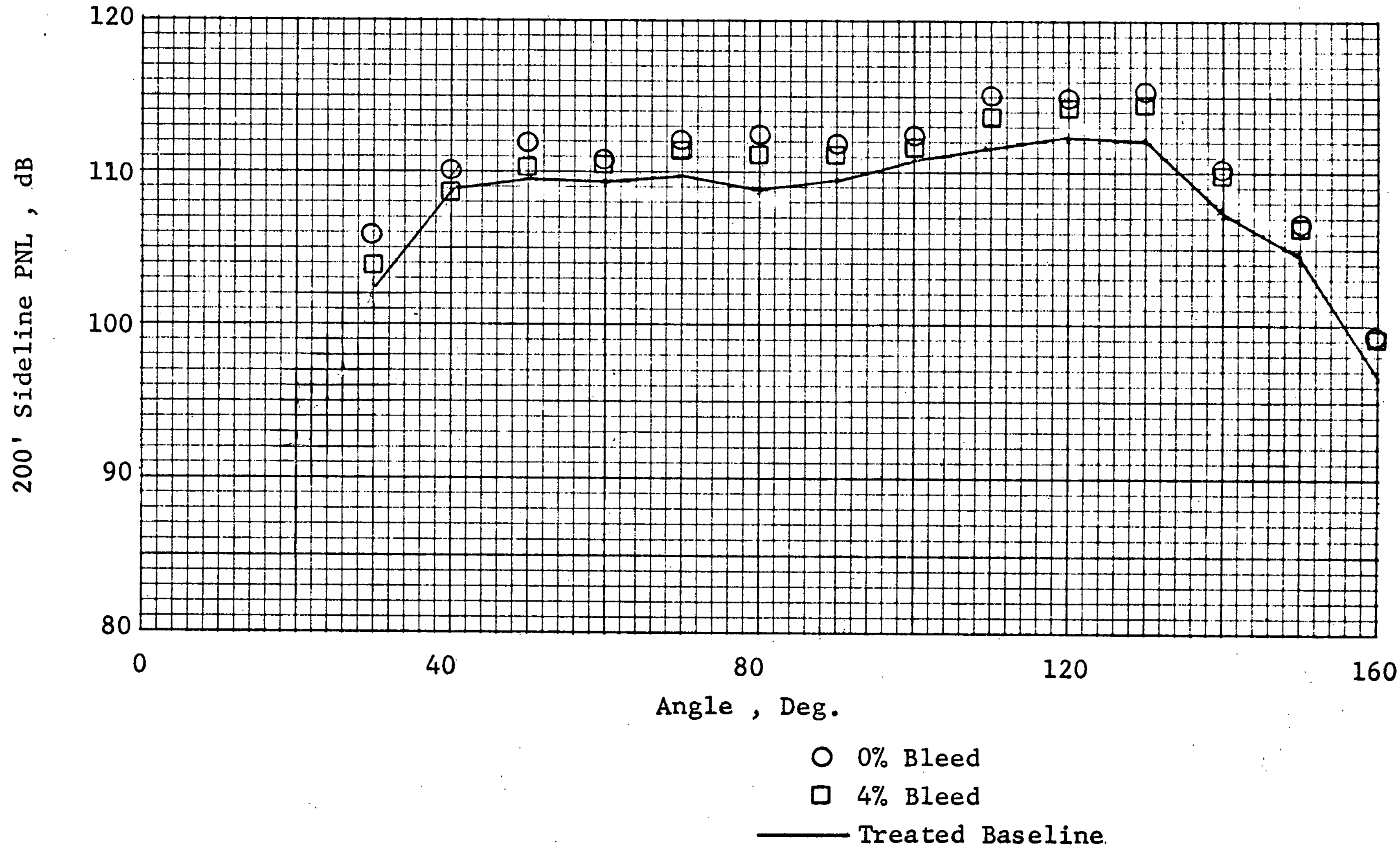


Figure 33

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL BLEED TEST RESULTS

200' SIDELINE PNL

TAKEOFF - SINGLE FAN

STANDARD DAY

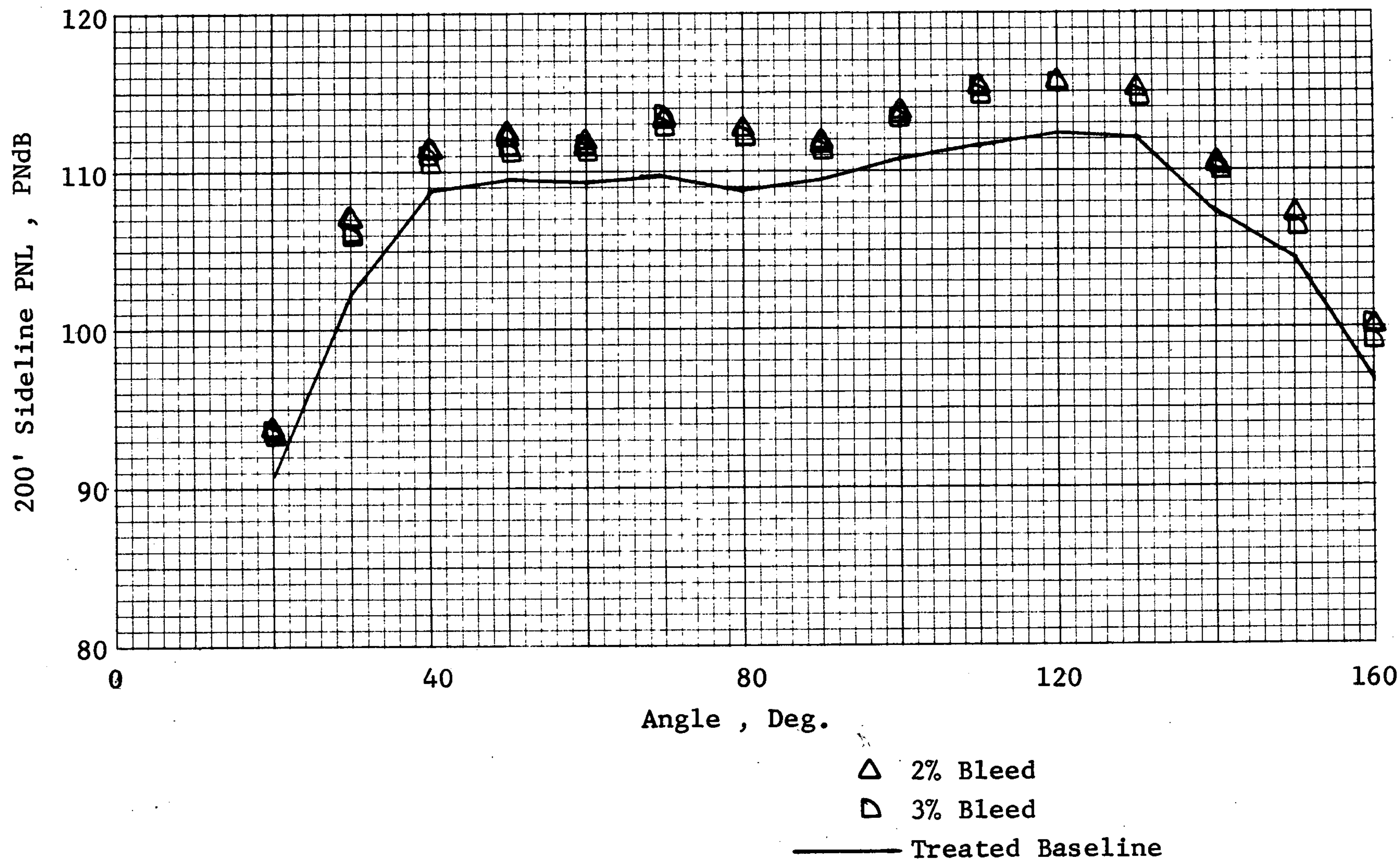


Figure 34

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL BLEED TEST RESULTS

200' SIDELINE MAX PNL

SINGLE FAN

STANDARD DAY

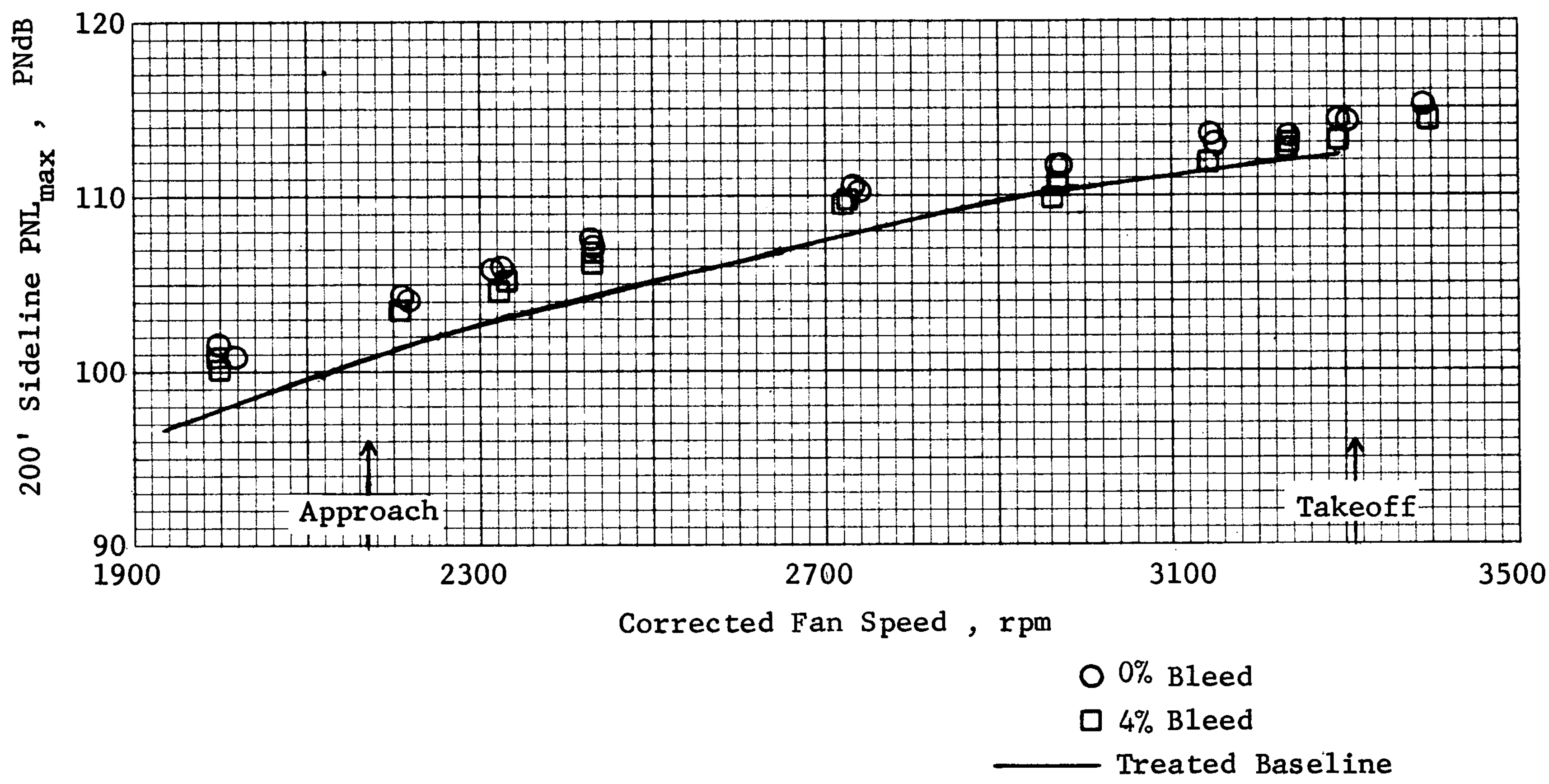


Figure 35

QEP FAN B

FULL SCALE PROJECTIONS FROM SCALE MODEL BLEED TEST RESULTS

200' SIDELINE MAX PNL

SINGLE FAN

STANDARD DAY

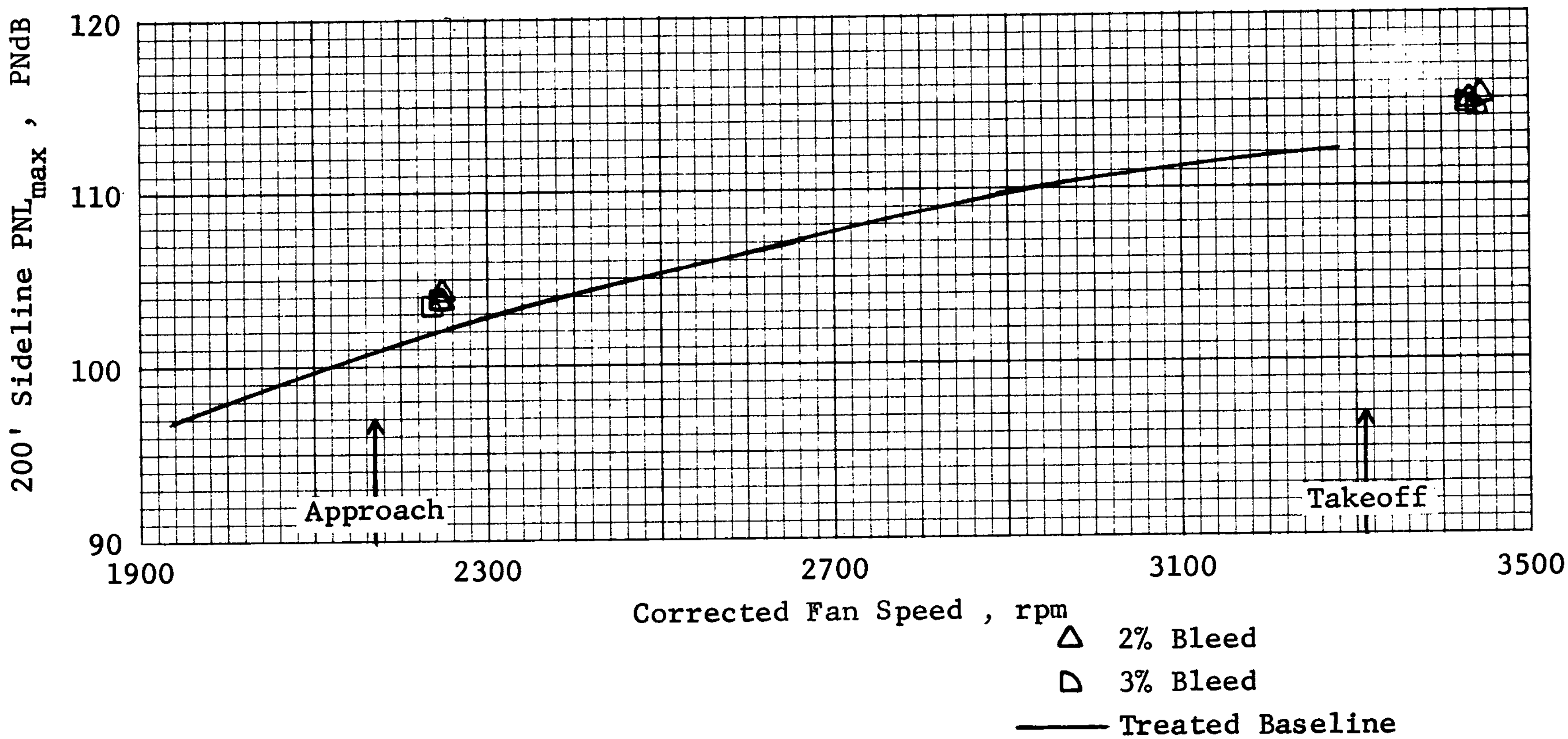


Figure 36

VII. Conclusions

From these data, it can be concluded:

1. The noise in the front quadrant decreased relative to the zero bleed baseline with increasing bleed rate.

2. The particular rotor tip casing bleed slot increased the noise level above that of the configuration without the bleed slot.

3. This type bleed might reduce noise if the inlet boundary layer is highly turbulent or if blow-in doors are being used.

Summarizing the results, projections of full scale Fan B indicate the following single fan, 200 foot (61.0 m) sideline maximum Perceived Noise Levels in both the front and rear quadrant for approach and takeoff thrusts:

FULL SCALE FAN B PROJECTIONS
200 FOOT (61.0 m) SIDELINE, MAXIMUM PNL
SINGLE FAN

	Front Quadrant		Rear Quadrant	
	Approach*	Takeoff**	Approach*	Takeoff**
0% Bleed	102.5 PNdB	112.5 PNdB	104.1 PNdB	115.6 PNdB
2% Bleed	102.2 PNdB	113.3 PNdB	104.0 PNdB	115.5 PNdB
3% Bleed	101.3 PNdB	113.1 PNdB	103.7 PNdB	115.3 PNdB
4% Bleed	100.0 PNdB	111.6 PNdB	103.6 PNdB	114.5 PNdB
Standard Casing	98.0 PNdB	109.9 PNdB	100.2 PNdB	112.4 PNdB

* 6,684 pounds (29,744 newtons) static fan thrust
**17,140 pounds (76,277 newtons) static fan thrust

VIII. Appendix

Tables A1 - A16 contain the 1/3 octave scale model data used to prepare this report. The data presented is for the 100 foot (30.5 m) arc and has been corrected to Standard Day conditions. Tables A1 - A4 contain the data for the fan frame treated configuration with the standard casing for speeds as close as possible to 60, 70, 80 and 90% corrected fan speed. Tables A5 - A8 present the data at these speeds for the configuration with the tip bleed casing but with zero bleed. Tables A9 - A12 contain the same set of information for the 4% bleed rate. Tables 13 - 14 present the 1/3 octave data for corrected speeds close to 60% and 90% at 2% bleed and Tables 15 - 16 contain similar information at the 3% bleed rate.

Figures 1A - 5A are the detailed drawings of the Rotor Tip Bleed Case. Figure 1A is the assembly drawing and the other four figures present the details of the integral parts. Figure 6A is a detailed drawing of the Inlet Boundary Layer Rake, including an installation view.

C.2

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 58.8% N_{fc} ; STANDARD CASING BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC. DATE - MONTH 12 DAY 8 HR. 20.8

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

RADIAL 100. FT. (30. M)
VEHICLE .5FAN
CONFIG FANB
LOC PTO
DATE 10/6/70
RUN 17. PT. 262.
TAPE T9541.
BAR 29.0 HG (97760. N/M2)
TAMB 73. DEG F (296. DEG K)
TWET 60. DEG F (289. DEG K)
HACT 9.52 GM/M3 (.00952 KG/M3)
NPA 4460. RPM (467. RAD/SEC)
NPK 4401. RPM (461. RAD/SEC)
NPD 7488. RPM (784. RAD/SEC)
NO. BLADES 26

FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
50	72.3	69.2	67.9	69.5	69.8	68.0	66.4	69.6	69.7	70.3	70.1	70.6	72.8	74.7	77.3			120.5
63	64.9	65.0	65.3	75.3	68.6	67.7	65.4	75.7	68.5	69.4	71.3	70.7	74.0	74.3	76.3			121.6
80	61.3	63.6	63.8	66.3	66.0	66.2	64.8	67.0	68.8	69.6	70.4	70.4	71.6	73.1	74.2			118.7
100	64.5	67.1	70.8	67.3	66.9	68.5	65.6	67.7	67.7	68.7	69.8	70.5	72.0	71.9	71.9			119.0
125	65.0	65.1	66.0	64.7	66.9	66.7	66.1	66.3	66.5	67.3	68.7	68.9	69.2	70.3	68.5			117.3
160	63.7	62.9	64.5	64.1	66.2	65.7	63.9	66.0	64.9	66.0	66.2	67.4	67.9	68.5	68.4			116.0
200	62.7	62.9	61.6	66.4	62.6	64.5	63.3	66.9	68.4	67.7	67.9	69.9	71.1	72.7	72.9			117.6
250	65.0	65.7	65.6	67.2	66.9	67.8	68.7	70.6	71.4	72.6	73.7	75.0	75.3	75.3	75.8			121.9
315	66.3	67.7	68.7	69.6	69.4	70.2	70.2	72.7	73.8	75.3	76.4	77.0	77.4	77.5	74.3			124.0
400	67.9	70.9	71.1	69.9	70.2	70.3	70.1	71.6	72.5	73.7	74.9	75.1	74.4	74.6	71.8			122.7
500	68.7	71.0	69.9	68.4	69.1	69.4	68.2	68.4	69.4	69.7	71.0	71.8	71.2	71.9	69.9			120.1
630	67.6	68.6	69.1	71.8	68.7	69.8	68.4	70.3	71.6	72.9	73.8	73.3	74.6	72.7	71.2			122.0
800	71.1	70.6	70.7	71.3	70.4	71.3	70.1	72.3	72.4	72.6	74.0	73.5	73.5	73.0	71.9			122.5
1000	69.0	69.4	73.6	70.3	70.6	69.9	69.2	71.3	72.2	73.9	75.6	76.1	75.2	73.8	72.2			123.2
1250	67.5	68.7	71.1	70.1	69.8	69.2	68.5	70.0	72.2	73.3	75.7	75.7	76.1	73.0	71.5			122.9
1600	70.4	71.0	71.7	71.0	70.0	69.4	68.7	70.5	72.8	74.8	76.4	76.9	78.2	74.6	72.6			124.1
2000	79.1	82.1	80.3	80.2	76.7	76.2	74.9	75.9	76.3	78.6	77.1	78.2	83.2	81.5	80.2			129.5
2500	66.7	69.6	67.1	66.7	66.5	65.2	66.0	66.0	69.0	70.2	71.6	75.1	74.4	71.2	69.3			120.8
3150	64.0	74.9	73.9	72.0	71.9	71.0	70.4	70.8	71.8	73.2	75.0	76.7	75.6	75.2	72.0			124.6
4000	69.9	80.8	82.7	79.9	78.5	77.4	73.4	74.9	76.5	76.4	76.8	80.8	80.6	81.8	78.4			130.1
5000	70.6	75.3	76.7	75.2	72.9	72.3	69.7	72.3	74.2	75.7	77.5	80.0	80.7	76.0	73.7			127.1
6300	71.0	78.6	79.1	77.8	76.7	74.8	72.3	72.4	73.6	75.1	78.0	80.6	82.5	76.9	74.2			128.9
8000	68.2	76.9	78.6	77.1	75.6	74.3	70.4	71.6	72.4	74.7	78.8	78.1	78.6	77.1	72.7			127.9
10000	66.5	75.8	77.7	77.0	74.7	73.5	69.2	70.2	72.1	72.9	75.0	75.4	76.4	73.8	71.1			127.3
12500	66.1	73.2	75.6	74.2	72.7	71.1	66.6	66.8	68.8	69.8	71.4	70.7	72.8	71.7	68.2			125.7
16000	64.8	69.6	73.3	70.8	69.7	68.7	64.4	64.6	66.7	66.2	67.9	66.0	67.0	68.1	65.8			124.6
20000	67.9	67.8	71.8	69.7	68.9	69.0	65.2	66.1	68.5	66.8	67.2	63.6	67.0	66.7	66.3			126.7
OVERALL MEASURED	85.3	89.3	90.0	88.6	87.0	86.2	84.1	85.9	87.0	88.6	89.8	91.5	92.4	90.7	88.6			
OVERALL CALCULATED	83.8	88.2	89.0	87.9	86.3	85.5	83.5	85.3	86.0	87.5	88.6	90.0	91.0	89.6	88.0			139.1
PNDB	97.1	101.8	102.9	101.2	99.9	99.1	98.5	98.0	99.3	100.9	101.9	103.6	103.9	103.4	100.8			

TABLE A1

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 73.0% N_{fc} ; STANDARD CASING BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC, DATE - MONTH 12 DAY 8 HR, 20,9

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ,	20, (0,35)	30, (0,52)	40, (0,70)	50, (0,87)	60, (1,05)	70, (1,22)	80, (1,40)	90, (1,57)	100, (1,75)	110, (1,92)	120, (2,09)	130, (2,27)	140, (2,44)	150, (2,62)	160, (2,79)	PWL
RADIAL 100, FT,	50	74,9	72,6	71,9	74,1	73,0	71,1	71,8	73,9	74,4	75,2	75,7	76,4	79,4	82,6	85,9	126,6
(30, M)	63	68,9	69,7	70,3	75,9	72,0	71,1	71,4	77,6	75,0	75,8	76,8	77,7	80,3	82,7	85,7	127,1
VEHICLE .5FAN	80	65,9	67,5	68,6	69,8	70,0	69,8	71,4	73,5	74,1	74,6	75,5	76,7	79,3	81,5	83,8	125,4
CONFIG FANB	100	74,8	71,2	74,6	74,1	74,7	74,8	76,7	78,2	76,3	76,1	77,4	78,3	80,6	80,7	82,4	127,2
LOC PTO	125	68,9	68,7	69,5	69,4	70,8	70,4	70,8	71,7	72,7	73,8	74,9	75,0	76,3	77,5	76,5	123,1
DATE 10/6/70	160	67,7	69,1	70,5	68,0	69,2	68,9	69,8	69,6	70,0	72,5	72,6	74,4	75,3	77,6	77,7	122,3
RUN 17, PT, 265	200	68,2	76,5	78,6	72,6	72,4	73,4	75,2	73,5	73,3	78,0	76,9	80,7	80,9	82,9	82,0	127,5
TAPE 9889,	250	69,0	70,8	73,4	73,6	74,2	74,6	75,2	77,3	78,2	80,0	81,7	83,0	84,3	85,4	84,0	129,8
BAR 29,0 HG	315	72,6	73,7	76,2	75,8	76,2	77,0	77,1	79,6	80,4	82,3	83,7	84,6	85,2	85,3	82,7	131,3
(97760, N/M2)	400	74,0	75,0	76,6	75,8	75,4	75,6	75,8	77,6	79,4	80,3	81,5	81,3	81,0	80,2	78,7	128,8
TAMB 69, DEG F	500	73,2	75,5	75,0	73,6	73,7	73,3	72,4	74,0	75,2	76,1	78,0	77,2	79,2	79,4	76,9	126,3
(294, DEG K)	630	71,9	73,9	74,7	75,0	73,8	75,0	75,3	77,8	79,5	80,5	81,4	82,3	82,2	80,3	79,0	129,1
TWET 59, DEG F	800	74,6	76,5	76,5	76,1	76,5	76,8	76,1	77,5	78,9	79,8	80,1	79,8	79,6	78,5	78,0	128,3
(288, DEG K)	1000	73,3	75,2	76,4	75,9	75,5	75,7	75,5	77,5	79,0	80,9	82,1	82,3	80,6	79,6	79,0	127,3
HACT 9,93 GM/M3	1250	72,6	74,2	76,0	75,8	75,6	75,4	74,8	76,3	78,5	79,8	82,2	82,0	80,8	78,6	77,1	128,9
(.00993 KG/M3)	1600	74,2	75,3	76,7	76,3	75,6	75,7	74,7	76,9	79,1	81,1	82,6	83,3	81,9	79,3	77,6	129,7
NFA 5521, RPM	2000	73,7	76,7	77,1	76,4	75,7	75,3	74,3	76,9	78,8	80,2	81,0	82,3	81,2	78,4	76,7	129,2
(578, RAD/SEC)	2500	79,1	85,4	84,7	85,6	83,8	81,6	80,0	78,5	80,1	81,4	81,7	85,0	84,0	85,2	81,7	134,0
NPK 5469, RPM	3150	69,2	80,4	79,1	75,1	78,1	77,5	77,0	77,5	78,3	80,2	82,1	85,2	80,0	80,3	77,0	130,8
(573, RAD/SEC)	4000	71,5	80,0	81,5	79,9	79,1	78,4	76,1	78,3	80,2	82,7	83,5	85,3	82,4	81,9	75,5	132,2
NFD 7488, RPM	5000	77,4	83,7	86,3	85,2	82,5	81,9	79,1	80,9	82,7	84,5	85,7	88,3	85,0	84,2	81,3	135,3
(784, RAD/SEC)	6300	75,2	82,6	82,7	82,2	81,3	79,9	78,5	79,1	80,5	82,3	85,1	87,4	84,2	81,4	78,3	134,1
NO, BLADES 26	8000	73,6	82,4	83,8	82,6	81,8	80,7	77,9	78,8	79,8	82,3	83,5	85,8	81,9	82,5	78,0	134,1
	10000	71,4	80,7	82,7	82,4	80,7	79,4	76,3	77,0	79,1	80,4	81,6	82,8	79,9	79,0	76,2	133,3
	12500	70,4	77,8	80,5	79,0	78,4	76,7	73,2	73,2	75,6	76,8	77,9	77,8	76,4	76,8	72,9	131,2
	16000	66,2	73,6	77,7	75,3	74,8	73,7	69,5	68,9	71,2	72,2	73,9	72,8	72,5	72,5	69,3	129,4
	20000	66,7	69,6	74,4	72,2	71,2	71,8	66,0	66,1	69,0	68,7	69,9	67,9	68,6	68,4	66,6	128,7
OVERALL MEASURED		89,1	94,7	94,9	94,2	93,0	92,3	91,1	92,4	93,8	95,5	96,8	96,6	97,0	96,8	95,2	
OVERALL CALCULATED		87,4	93,3	93,6	93,0	91,9	91,1	89,8	91,2	92,4	94,1	95,3	95,9	95,6	95,6	94,7	144,8
	PNDB	100,6	107,6	107,1	106,4	105,2	104,1	102,8	104,0	105,4	107,2	108,4	110,4	108,2	108,1	105,6	

TABLE A2

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 79.3% N_{fc} ; STANDARD CASING BASELINE

PAGE 1 NASAQUIETENGINE 1/2SCALEFAN PROC, DATE - MONTH 12 DAY 8 HR, 20,9

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ	20, (0,35)	30, (0,52)	40, (0,70)	50, (0,87)	60, (1,05)	70, (1,22)	80, (1,40)	90, (1,57)	100, (1,75)	110, (1,92)	120, (2,09)	130, (2,27)	140, (2,44)	150, (2,62)	160, (2,79)	( )	( )	PWL
RADIAL 100, FT,	50	76,2	74,8	74,1	74,8	74,4	72,6	73,8	76,1	76,8	77,8	78,1	79,0	82,5	86,2	89,5			129,5
(30, M)	63	70,5	72,2	73,2	76,7	74,3	73,1	74,0	78,9	77,5	78,7	79,1	79,9	83,1	86,1	89,3			129,8
VEHICLE ,5FAN	80	67,5	69,9	70,7	72,0	71,1	70,5	72,9	75,2	76,8	77,5	78,5	79,5	82,3	84,9	87,3			128,4
CONFIG FANB	100	73,8	72,1	75,9	77,4	76,6	78,4	79,2	78,6	77,8	81,1	83,9	85,4	85,2	84,7	86,9			131,3
LOC PTO	125	71,4	71,8	73,1	72,9	73,4	73,1	73,6	74,4	75,3	76,5	77,8	78,3	79,6	81,0	80,1			126,2
DATE 10/6/70	160	70,4	69,7	70,5	69,9	71,2	70,5	71,0	71,6	72,8	74,5	75,4	77,2	78,9	81,6	81,5			125,1
RUN 17, PT, 266,	200	75,7	72,8	71,5	72,0	71,0	74,0	72,8	75,2	76,0	79,3	79,8	82,0	84,0	86,4	86,0			129,5
TAPE 79889,	250	70,0	72,4	74,5	76,0	79,8	76,9	77,7	79,4	80,5	82,4	84,2	85,9	87,6	89,1	87,4			132,8
BAR 29,0 HG	315	75,1	76,3	78,6	78,5	78,8	79,5	80,0	82,0	83,3	84,9	86,6	87,6	88,5	88,7	86,4			134,2
(97760, N/M2)	400	76,5	77,7	79,1	78,4	78,0	78,1	78,6	80,1	82,1	83,3	84,6	84,8	84,4	83,3	82,2			131,8
TAMB 69, DEG F	500	76,0	77,7	76,1	76,0	76,4	76,2	75,6	76,1	77,8	78,7	80,9	82,3	82,8	82,9	79,7			129,2
(294, DEG K)	630	74,5	77,1	78,2	75,9	78,8	78,6	79,2	81,5	82,5	83,2	84,6	85,6	85,5	83,7	82,2			132,3
TWET 59, DEG F	800	75,9	78,7	79,2	79,0	80,5	80,6	79,6	80,4	82,1	83,6	83,4	83,1	82,9	81,4	80,6			131,7
(288, DEG K)	1000	75,1	77,6	78,2	78,4	77,9	78,0	77,9	79,8	81,2	83,2	84,7	84,9	83,0	81,9	81,0			131,7
HACT 9,93 GM/M3	1250	74,7	76,3	77,9	78,1	77,6	77,7	76,9	78,7	80,5	82,1	84,3	84,1	82,6	80,5	79,2			131,0
(,00993 KG/M3)	1600	75,7	76,4	78,5	78,0	77,6	78,0	76,9	78,8	80,9	82,9	84,9	85,3	83,5	80,9	79,1			131,7
NFA 5996, RPM	2000	74,5	76,0	77,7	77,0	76,4	76,4	76,0	78,4	80,2	81,8	83,1	84,3	82,2	79,0	77,6			130,6
(628, RAD/SEC)	2500	81,7	91,7	89,1	88,8	89,6	85,2	84,5	82,9	83,1	83,1	85,9	90,7	85,4	88,2	84,8			137,9
NFK 5939, RPM	3150	72,2	82,9	81,5	80,4	81,0	79,9	79,7	79,5	80,2	82,2	84,9	87,5	81,1	82,5	79,0			133,1
(622, RAD/SEC)	4000	70,8	79,9	81,6	80,1	79,6	79,3	77,6	79,9	82,5	84,8	86,7	87,1	83,1	83,1	79,7			133,8
NFD 7488, RPM	5000	79,4	85,7	87,7	86,8	84,5	84,0	81,1	82,4	84,5	86,5	88,9	90,3	85,9	85,1	83,0			137,3
(784, RAD/SEC)	6300	76,1	83,0	83,7	82,8	82,0	81,1	80,3	81,2	82,5	84,6	87,8	89,4	84,7	82,8	80,0			135,8
NO, BLADES 26	8000	75,2	83,4	86,1	84,3	83,0	82,5	80,1	81,1	81,8	84,8	86,3	87,9	83,2	84,3	80,0			136,2
	10000	72,6	81,3	83,8	83,5	81,6	81,2	78,5	79,1	81,0	82,2	84,3	85,0	81,3	80,6	77,8			135,0
	12500	71,2	78,0	81,4	79,9	79,2	77,9	75,2	75,5	78,0	79,1	80,8	80,5	77,7	77,9	74,2			132,9
	16000	66,6	73,5	78,2	75,8	75,4	74,6	71,1	70,9	73,4	74,4	76,8	75,5	73,8	73,4	70,3			130,8
	20000	66,7	69,3	74,8	72,6	71,6	72,3	67,9	67,6	70,6	70,7	72,8	70,7	69,6	69,3	67,5			129,8
	OVERALL MEASURED	91,0	96,9	97,0	96,2	95,9	94,6	93,8	94,7	96,1	97,9	99,9	101,3	99,3	99,6	98,3			
	OVERALL CALCULATED	89,3	95,3	95,5	94,9	94,5	93,3	92,4	93,4	94,7	96,4	98,3	99,7	97,9	98,4	98,0			147,2
	PNDB	102,7	110,0	109,3	108,8	108,9	106,8	106,0	106,1	107,6	109,4	111,5	113,0	109,8	110,7	108,4			

TABLE A3

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 90.7% N_{fc} ; STANDARD CASING BASELINE

PAGE 1   NASAQUIETENGINE   1/2SCALEFAN   PROC. DATE - MONTH 12 DAY 8 HR. 20.8

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50	78.1	76.9	75.4	76.8	76.0	74.7	76.8	79.3	79.9	81.0	81.4	82.3	85.9	90.0	93.8			133.0
(30. M)	63	74.5	77.6	77.4	80.3	77.2	76.8	77.7	80.4	80.9	81.9	83.6	84.6	87.7	91.7	95.1			134.6
VEHICLE .5FAN	80	71.7	73.8	72.6	74.2	75.1	75.2	77.1	79.1	80.6	81.6	81.9	83.2	86.8	90.0	92.7			133.0
CONFIG FANB	100	74.7	75.7	74.2	77.2	76.9	76.8	78.2	79.2	80.9	82.1	82.7	84.8	86.9	89.3	89.9			132.6
LOC PTO	125	79.0	77.0	76.1	76.9	79.1	77.7	79.9	78.5	80.3	83.0	82.0	86.8	86.2	87.0	85.8			132.2
DATE 10/6/70	160	73.3	73.0	73.4	73.1	74.5	73.9	74.6	75.0	76.4	78.3	80.0	81.7	83.5	86.7	87.1			129.6
RUN 17. PT. 270.	200	72.6	73.6	72.8	75.2	75.8	77.1	77.0	78.6	80.0	82.1	84.0	86.6	87.2	91.9	90.7			134.0
TAPE 9889.	250	78.8	77.1	78.9	81.1	81.7	82.3	82.0	83.9	85.2	89.7	89.0	90.9	93.1	95.0	92.8			138.0
BAR 29.0 HG	315	80.4	81.1	82.3	82.7	83.3	84.0	84.4	86.2	87.4	89.3	91.2	92.6	93.9	94.7	92.1			139.2
(97794. N/M2)	400	80.6	81.5	82.6	81.3	82.1	82.1	82.9	84.2	85.8	86.8	88.5	89.1	89.6	88.9	87.8			136.1
TAMB 68. DEG F	500	79.3	80.8	80.0	79.7	79.9	80.4	79.3	80.9	81.8	83.3	85.9	87.2	87.9	88.0	84.7			133.7
(293. DEG K)	630	77.3	78.9	78.9	78.2	79.1	81.0	81.5	83.8	89.9	86.8	89.6	88.9	90.2	88.3	86.6			135.8
TWET 58. DEG F	800	77.9	79.7	81.1	80.2	81.8	82.5	82.5	83.7	84.9	85.6	86.5	86.2	86.9	86.0	84.4			134.5
(288. DEG K)	1000	78.3	80.3	81.0	81.2	81.2	81.5	82.1	83.8	85.7	87.6	88.8	88.1	87.0	86.5	84.9			135.6
HACT 9.50 GM/M3	1250	78.4	80.1	82.5	81.5	81.5	81.7	81.1	81.9	83.6	85.0	86.8	85.9	86.3	85.1	83.5			134.3
(.00950 KG/M3)	1600	79.8	81.1	83.2	83.6	81.5	81.3	80.7	82.4	84.4	85.4	88.2	83.6	86.9	85.2	83.4			134.6
NFA 6850. RPM	2000	78.1	79.1	80.9	80.9	79.2	79.4	78.7	81.1	82.7	83.6	84.1	85.3	84.8	82.9	81.1			132.8
(717. RAD/SEC)	2500	76.9	84.2	86.0	84.7	83.5	83.9	82.2	81.3	81.6	82.2	84.8	87.9	82.8	83.8	80.9			134.5
NFK 6791. RPM	3150	84.6	94.2	98.6	96.6	95.0	95.6	92.0	90.4	89.1	89.8	92.8	95.3	89.5	93.9	89.3			144.7
(711. RAD/SEC)	4000	78.3	81.2	83.7	82.5	82.9	82.7	81.3	83.3	85.0	87.1	88.2	88.1	84.5	85.2	82.6			135.9
NFD 7488. RPM	5000	77.5	82.9	85.3	83.6	82.7	82.5	81.4	83.3	85.9	87.4	89.4	88.3	85.3	84.1	82.8			136.6
(784. RAD/SEC)	6300	82.5	89.4	90.2	89.4	89.0	87.1	86.4	86.3	87.6	88.5	91.3	92.8	89.4	86.9	85.4			140.6
NO. BLADES 26	8000	74.7	81.7	84.8	83.7	83.5	83.1	81.8	83.6	84.6	87.3	88.6	89.3	84.1	84.3	80.7			137.4
	10000	73.1	80.7	84.2	83.7	82.8	82.3	80.7	82.5	84.3	85.7	87.0	87.0	82.9	81.8	79.8			135.9
	12500	71.1	76.6	81.1	80.0	79.7	78.8	77.0	78.7	82.1	82.6	83.8	82.4	79.1	78.8	75.6			134.7
	16000	66.3	71.6	77.6	75.4	75.1	75.2	72.3	73.9	76.2	77.6	79.7	77.2	75.2	75.0	72.9			132.1
	20000	66.7	67.4	74.1	72.2	71.3	72.8	68.1	70.4	73.0	73.8	77.8	73.5	73.2	74.2	73.3			131.7
	OVERALL MEASURED	93.7	99.2	101.9	100.5	99.8	99.8	98.2	98.5	99.8	101.1	102.8	104.1	103.3	104.3	102.8			
	OVERALL CALCULATED	92.3	97.6	100.7	99.3	98.3	98.5	96.7	97.3	98.3	99.7	101.4	102.6	102.0	103.2	102.7			150.8
	PNDB	109.1	112.9	116.1	114.7	113.7	114.0	111.8	111.6	111.8	112.9	114.9	116.7	113.7	115.6	112.9			

TABLE A4

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 61.1% N_{fc} ; BLEED CASING, 0% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 14 HR. 15.2

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	PWL
RADIAL 100. FT.	50		59.0	66.3	69.4	67.5	68.6	69.6	71.3	70.3	71.3	71.5	72.2	74.6	76.8	79.3	121.5
(30. M)	63		67.5	65.7	73.1	68.9	68.9	69.5	75.5	69.9	70.9	72.4	72.6	76.0	76.7	78.8	122.4
VEHICLE .5 FAN	80		67.1	70.4	70.4	68.5	68.6	71.0	71.6	71.4	71.3	72.6	74.4	75.3	76.2	77.8	122.0
CONFIG FAN B	100		69.1	73.7	74.9	73.7	72.4	73.9	72.8	70.9	71.1	71.6	72.5	73.5	74.9	75.4	122.7
LOC PTO	125		67.1	68.1	67.1	67.9	67.6	68.0	68.9	68.2	69.2	70.1	70.4	70.8	72.7	71.7	118.9
DATE 12/18/70	160		70.5	66.9	69.0	67.9	67.8	66.4	71.2	69.9	69.7	69.1	71.4	71.3	72.1	72.7	119.5
RUN 258, PT. 376	200		66.8	66.4	69.2	65.9	68.6	67.1	68.0	68.2	69.7	70.2	72.0	73.6	75.1	74.8	119.9
TAPE S1245,	250		68.8	69.3	71.1	69.0	71.0	71.2	72.3	73.2	74.1	75.3	76.5	77.3	78.3	77.2	123.7
BAR 28.9 HG	315		69.9	72.9	72.7	73.2	72.3	72.8	75.8	76.6	76.9	77.7	78.4	79.0	79.1	76.9	125.9
(97713, N/M2)	400		71.9	75.4	73.6	73.9	72.5	76.0	74.1	75.3	76.2	76.8	77.2	76.8	76.8	75.3	125.3
TAMB 35. DEG F	500		71.7	71.9	70.5	71.0	71.1	71.4	70.1	70.8	72.3	72.7	74.2	73.9	73.6	72.7	122.0
(275, DEG K)	630		71.0	72.3	71.3	71.5	71.5	70.6	73.8	74.5	75.7	76.8	76.9	77.2	76.7	75.5	124.5
TWET 34. DEG F	800		71.2	71.2	69.8	71.0	71.2	72.4	73.4	72.9	74.1	75.6	76.5	74.8	74.3	73.4	123.5
(274, DEG K)	1000		71.4	72.0	71.9	70.5	70.7	72.1	73.8	73.8	75.7	77.2	78.7	77.7	74.5	73.1	124.7
HACT 4.41 GM/M3	1250		70.6	72.1	70.5	69.7	70.1	69.9	71.1	72.5	74.8	77.5	77.9	76.9	73.7	72.1	124.0
(.00441 KG/M3)	1600		75.5	74.5	72.9	72.1	72.1	71.0	72.0	73.6	76.1	78.9	79.6	78.9	76.7	74.2	125.9
NFA 4470. RPM	2000		88.4	86.1	83.7	83.0	83.1	80.2	79.6	81.0	82.9	84.9	87.7	88.0	88.4	85.3	135.2
(465, RAD/SEC)	2500		75.2	74.9	72.9	71.5	71.4	70.2	71.1	72.5	75.0	76.1	78.9	78.0	75.3	73.1	125.0
NFK 4573. RPM	3150		76.3	75.0	74.4	71.5	71.5	70.5	70.9	72.7	73.4	74.3	80.5	79.9	76.2	73.9	125.8
(479. RAD/SEC)	4000		88.1	86.7	86.4	82.2	79.4	79.4	79.0	79.9	79.1	81.8	86.8	86.1	86.4	82.9	134.6
NFD 7485. RPM	5000		79.1	80.4	77.6	76.6	77.2	71.9	72.8	73.9	77.6	79.9	81.6	81.4	78.0	74.7	129.0
(784. RAD/SEC)	6300		83.4	83.4	82.8	79.0	79.3	76.2	75.8	76.4	79.7	80.7	84.5	84.6	79.9	77.9	132.3
NO. BLADES 26	8000		83.7	84.1	82.0	80.1	78.7	74.4	74.8	75.4	78.0	79.6	82.3	81.7	80.2	75.8	132.0
	10000		82.0	81.0	81.0	77.1	77.6	72.9	73.0	74.0	76.6	76.9	80.5	79.2	77.5	74.1	130.8
	12500		78.7	79.6	78.2	75.7	75.3	70.1	69.5	70.3	73.1	74.4	76.5	76.8	74.6	71.2	129.3
	16000		76.8	77.9	75.2	73.4	72.4	67.4	67.5	67.5	69.6	71.1	73.9	73.9	72.5	69.6	128.8
	20000		76.0	76.6	74.6	71.5	71.1	65.8	66.7	66.7	68.5	70.0	72.6	72.5	71.2	69.1	130.2
OVERALL MEASURED			94.5	93.9	92.6	90.1	89.9	88.5	88.9	89.4	90.9	92.7	95.1	95.1	94.5	92.5	
OVERALL CALCULATED			93.9	93.2	92.1	89.7	89.2	87.5	87.9	88.5	90.0	91.6	94.3	94.1	93.4	91.3	142.6
PNDB			107.5	105.8	106.1	103.2	102.2	101.1	101.2	102.0	103.1	104.8	108.2	107.8	107.1	104.5	

TABLE A5

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 67.0% N_{fc} ; BLEED CASING, 0% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 14 HR. 18.1

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50		71.2	70.7	72.2	71.9	72.1	72.1	73.6	73.3	74.0	74.0	75.1	77.5	80.7	83.3			124.7
(30. M)	63		68.4	70.4	73.7	70.2	70.6	71.4	76.4	72.4	73.8	74.7	75.2	78.3	80.6	82.9			124.9
VEHICLE .5 FAN	80		73.1	75.9	80.6	75.4	77.3	78.9	78.2	80.5	80.3	77.9	75.3	77.6	79.5	81.9			128.2
CONFIG FAN B	100		70.6	70.7	76.2	74.5	73.6	75.5	74.1	74.8	75.5	74.2	75.2	76.5	78.3	78.5			124.8
LOC PTO	125		68.2	70.3	68.3	69.4	69.2	70.1	70.8	71.2	72.0	72.6	72.9	73.7	75.1	74.2			121.2
DATE 12/18/70	160		71.3	71.1	68.8	70.2	73.1	72.0	70.7	71.5	75.5	71.5	72.3	76.8	76.3	75.5			122.7
RUN 25B, PT. 378	200		67.0	68.0	67.7	67.3	68.4	68.7	70.2	70.9	72.3	73.0	75.1	77.3	79.2	79.0			122.8
TAPE S1246.	250		70.2	71.2	71.7	70.9	72.7	73.6	75.1	76.1	76.4	77.8	79.4	80.8	81.9	80.8			126.5
BAR 28.9 HG	315		72.1	74.6	74.6	74.7	74.9	76.3	77.6	78.8	79.8	80.6	81.4	82.3	82.8	80.3			128.7
(97713, N/M2)	400		73.9	76.3	74.4	75.3	74.3	76.7	76.4	78.0	79.2	79.9	80.0	79.9	79.5	78.0			127.6
TAMB 36, DEG F	500		73.2	73.8	71.4	73.0	72.3	72.7	72.1	73.6	74.7	75.7	76.6	77.6	76.9	75.2			124.3
(275, DEG K)	630		72.1	73.5	72.2	71.7	72.7	73.7	75.9	77.6	78.5	79.5	79.7	80.3	79.1	77.0			126.9
TWET 34, DEG F	800		72.6	73.7	72.6	73.7	73.4	74.2	75.4	75.9	77.4	78.7	79.4	77.5	77.0	75.2			126.1
(274, DEG K)	1000		73.3	74.3	73.0	72.8	72.7	73.7	75.8	77.2	78.9	80.1	81.3	79.7	77.1	75.8			127.2
HACT 4.41 GM/M3	1250		72.1	74.1	72.7	72.5	72.4	72.7	73.6	75.6	77.6	80.2	80.5	78.7	76.1	74.4			126.5
(.00441 KG/M3)	1600		74.9	75.3	73.8	73.2	73.2	73.4	74.1	76.0	78.4	81.3	81.6	79.4	77.0	75.2			127.5
NFA 4907, RPM	2000		87.5	88.0	85.3	84.2	83.2	81.5	81.8	82.4	83.4	86.5	89.1	87.0	90.2	87.4			136.2
(514, RAD/SEC)	2500		80.2	80.4	78.2	76.9	76.2	75.0	75.4	76.5	78.5	80.3	83.0	81.2	81.7	78.9			129.6
NFK 5020, RPM	3150		77.1	76.4	75.6	73.3	73.7	73.3	73.4	75.3	76.0	77.0	82.8	82.0	77.7	75.5			127.9
(526, RAD/SEC)	4000		90.7	92.5	89.4	86.5	82.5	82.7	81.8	81.9	82.4	85.6	88.7	86.3	86.6	83.7			137.6
NFD 7488, RPM	5000		82.8	84.7	81.6	80.6	80.0	76.2	76.7	77.3	80.6	83.5	84.8	83.2	81.0	77.7			132.4
(784, RAD/SEC)	6300		86.9	84.7	85.2	82.1	80.4	80.3	79.5	79.5	82.3	83.8	87.4	86.4	82.8	80.7			134.9
NO. BLADES 26	8000		84.3	86.4	83.6	82.2	80.9	77.5	77.4	78.2	81.2	82.6	84.9	83.5	81.6	77.7			134.2
	10000		83.8	83.9	82.5	80.5	79.2	75.9	75.7	77.0	78.7	79.4	82.7	80.8	79.3	75.9			133.0
	12500		80.8	81.9	80.0	77.9	77.6	73.5	72.6	74.4	76.0	77.3	79.2	78.2	76.8	73.4			131.7
	16000		79.1	80.8	77.3	76.9	75.3	71.5	70.8	73.7	73.0	74.0	76.7	75.6	74.6	72.1			131.7
	20000		77.8	78.9	76.3	75.3	73.9	70.3	69.9	75.5	72.0	72.2	74.7	74.0	72.6	71.4			133.1
OVERALL MEASURED			96.0	97.3	95.0	93.4	92.0	91.5	91.7	92.8	93.9	95.4	97.4	96.4	96.6	95.1			
OVERALL CALCULATED			95.5	96.6	94.5	92.5	91.2	90.4	90.5	91.5	92.8	94.5	96.6	95.5	95.6	94.0			145.1
	PNDB		109.7	111.1	108.8	106.6	104.5	104.2	104.0	104.6	105.8	108.0	110.5	109.0	109.0	106.6			

TABLE A6

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 82.0% N_{f_c} ; BLEED CASING, 0% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 14 HR. 18.1

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50		75.9	75.3	75.9	74.7	75.2	76.8	78.3	78.1	79.9	80.1	80.9	83.9	88.4	91.8			131.3
(30. M)	63		73.4	74.9	76.2	75.2	75.5	76.4	79.1	78.0	79.4	80.2	81.3	84.3	88.5	91.8			131.4
VEHICLE .5 FAN	80		73.2	73.6	74.5	73.9	74.8	76.1	77.5	77.8	76.9	79.8	81.3	84.0	87.5	89.8			130.4
CONFIG FAN B	100		79.4	79.5	77.8	77.8	80.1	84.9	85.3	84.5	82.5	82.5	83.2	84.8	87.1	87.8			133.1
LOC PTO	125		74.0	74.8	74.0	73.5	74.3	75.8	76.0	76.3	77.9	78.7	79.5	80.7	83.0	82.5			127.5
DATE 12/18/70	160		72.3	72.4	70.9	72.8	72.3	73.5	73.8	74.4	76.7	77.4	79.1	80.6	82.9	83.2			126.7
RUN 259. PT. 380	200		72.0	72.9	73.7	75.3	75.7	76.5	77.2	76.7	78.8	81.0	83.8	86.4	87.7	87.1			130.8
TAPE S1246.	250		74.5	75.4	76.8	76.8	78.4	79.5	80.5	81.5	83.1	84.7	86.8	88.7	90.4	88.9			133.7
BAR 28.9 HG	315		78.1	79.7	79.4	80.9	81.0	81.8	83.5	85.1	87.1	87.4	88.5	89.9	90.6	88.7			135.6
(97713. N/M2)	400		79.9	81.1	78.7	79.6	79.4	81.4	82.3	84.0	86.0	86.3	86.8	87.0	87.3	85.7			134.0
TAMB 36. DEG F	500		77.9	77.1	76.8	76.6	76.7	77.3	77.7	79.3	81.1	82.5	83.2	84.9	84.6	82.3			130.5
(275. DEG K)	630		77.0	78.8	77.2	77.7	79.9	81.9	84.2	85.5	87.1	87.3	87.0	87.6	86.7	84.6			134.6
TWET 34. DEG F	800		77.9	78.9	77.8	78.4	79.0	80.0	82.1	83.0	83.6	84.8	85.4	83.7	83.4	81.4			132.3
(274. DEG K)	1000		78.4	77.4	77.2	77.6	78.1	79.1	81.0	82.2	83.9	85.4	86.5	84.4	82.9	81.1			132.3
HACT 4.41 GM/M3	1250		76.4	76.8	76.2	77.0	77.9	77.4	78.9	80.2	82.5	84.5	85.1	83.0	81.2	79.5			131.0
(.00441 KG/M3)	1600		78.6	78.0	77.5	77.4	78.4	78.3	80.3	81.2	82.7	85.3	85.4	83.0	81.3	79.5			131.7
NFA 6000. RPM	2000		81.0	81.1	79.3	78.5	78.8	79.0	80.1	81.4	83.1	85.3	86.9	83.3	82.0	80.5			132.6
(628. RAD/SEC)	2500		96.2	95.7	94.0	92.7	91.7	88.5	88.0	89.2	90.5	93.5	95.9	93.0	93.4	90.4			143.3
NFK 6138. RPM	3150		84.1	83.5	82.2	80.6	80.8	79.4	79.6	81.1	82.0	84.0	87.8	85.5	83.2	81.1			133.6
(643. RAD/SEC)	4000		84.4	83.9	82.6	80.4	79.4	81.7	82.3	83.8	84.4	87.1	88.6	85.1	84.2	81.6			135.1
NFD 7488. RPM	5000		90.9	93.4	88.5	89.3	90.5	84.0	84.7	85.5	89.0	91.4	92.3	88.5	90.6	86.8			140.6
(784. RAD/SEC)	6300		85.7	85.8	84.3	82.0	82.3	82.1	83.2	83.7	86.7	88.3	90.6	86.3	84.6	82.3			137.0
NO. BLADES 26	8000		91.0	92.5	89.1	87.8	86.4	84.4	84.6	84.8	87.6	89.0	91.2	87.4	88.7	84.6			140.3
	10000		87.3	88.0	86.6	84.2	83.2	81.8	82.3	82.8	85.1	85.5	88.3	84.2	84.4	81.4			137.9
	12500		83.8	85.6	83.2	80.6	81.1	79.2	78.9	79.8	82.3	83.4	85.1	82.0	81.1	77.9			136.2
	16000		81.4	84.1	80.3	79.6	78.3	76.8	76.5	76.9	78.9	80.2	82.2	79.3	78.0	75.7			135.6
	20000		79.7	81.8	78.9	77.6	76.6	74.8	74.6	75.7	77.2	77.9	80.0	77.4	75.5	74.1			136.2
OVERALL MEASURED			100.5	101.1	98.7	98.0	97.8	96.4	97.1	98.0	99.7	101.4	102.9	101.5	102.4	101.6			
OVERALL CALCULATED			99.8	100.4	98.0	97.1	96.9	95.4	96.1	96.9	98.7	100.4	102.0	100.4	101.2	100.4			150.0
PNDB			114.0	114.0	112.2	111.3	110.9	109.1	109.4	110.4	112.1	114.3	116.2	114.0	114.3	112.0			

TABLE A7

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 93.6% N_{fc} ; BLEED CASING, 0% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 14 HR. 18.1

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50	78.1	78.9	77.8	77.4	78.0	79.5	80.9	81.8	83.2	83.2	84.6	88.0	92.8	96.2				135.2
(30. M)	63	79.2	79.8	79.2	79.0	79.7	79.7	82.2	81.9	83.4	83.9	85.6	88.7	93.3	96.4				135.8
VEHICLE .5 FAN	80	76.9	79.1	78.5	78.0	78.7	80.0	81.4	81.7	83.4	84.1	85.6	88.6	92.7	94.9				135.1
CONFIG FAN B	100	77.7	79.4	79.9	78.9	79.9	81.5	82.1	82.3	84.2	84.5	86.3	88.4	91.9	92.0				134.6
LOC PTO	125	77.7	79.4	77.5	78.3	78.5	79.9	81.4	81.1	84.0	83.1	85.5	85.9	88.3	86.8				132.5
DATE 12/18/70	160	75.4	77.8	75.0	76.9	76.3	77.5	78.2	78.6	81.0	81.3	83.2	85.2	88.0	87.8				131.2
RUN 258. PT. 384	200	76.5	78.0	77.8	77.6	78.1	78.7	79.6	81.0	83.2	85.1	87.8	90.6	93.2	92.4				135.3
TAPE S1246.	250	80.3	82.0	82.9	81.7	82.8	83.4	84.6	86.0	87.6	89.4	91.8	94.2	96.2	94.5				138.9
BAR 28.9 HG	315	83.3	86.0	83.9	85.0	85.1	86.1	87.7	88.5	90.7	92.0	93.9	95.4	96.3	94.0				140.5
(97713. N/M2)	400	83.0	85.2	82.8	83.7	84.0	85.3	86.8	88.1	89.6	90.6	91.3	92.0	91.9	90.6				138.3
TAMB 36. DEG F	500	81.4	81.7	80.5	80.7	81.2	81.4	82.7	83.7	85.4	86.4	88.1	90.4	90.1	87.8				135.3
(275. DEG K)	630	80.0	81.6	80.4	81.2	82.3	83.8	86.1	87.8	89.7	91.0	91.4	92.3	91.4	89.0				138.0
TWET 34. DEG F	800	80.6	82.4	82.0	82.2	82.3	83.8	85.8	86.8	87.8	88.9	89.6	89.0	88.1	86.2				136.4
(274. DEG K)	1000	80.9	82.9	83.1	82.7	82.3	83.3	85.2	87.3	89.3	90.9	91.8	89.6	88.4	86.5				137.5
HACT 4.41 GM/M3	1250	81.1	83.2	82.1	82.4	83.3	82.8	83.3	84.9	87.0	88.3	89.4	88.0	86.5	84.8				135.7
(.00441 KG/M3)	1600	81.8	82.9	83.1	82.8	83.0	82.8	84.2	85.0	86.5	88.3	89.1	87.9	87.0	85.3				135.9
NFA 6850. RPM	2000	83.8	86.1	83.5	82.7	82.8	82.9	83.8	85.5	86.8	88.8	90.1	87.2	86.2	84.6				136.3
(717. RAD/SEC)	2500	87.3	89.1	87.9	86.6	87.1	85.3	85.0	85.6	87.6	89.3	91.2	86.9	87.5	85.7				138.1
NFK 7007. RPM	3150	95.9	98.3	96.8	95.1	95.7	93.5	92.2	91.4	92.8	94.3	96.9	93.9	94.9	92.8				145.5
(734. RAD/SEC)	4000	88.3	89.0	89.0	86.7	84.6	86.1	86.2	87.2	87.7	89.8	90.9	87.3	88.3	85.4				138.7
NFD 7488. RPM	5000	87.3	89.3	88.2	87.2	87.5	84.7	84.8	85.5	89.2	91.3	89.6	86.3	87.0	83.8				138.8
(784. RAD/SEC)	6300	93.4	93.2	94.0	90.3	90.7	91.2	89.2	89.8	93.8	94.4	96.8	92.2	90.6	88.8				144.0
NO. BLADES 26	8000	87.9	89.6	88.3	87.1	86.9	85.6	85.6	86.6	89.6	90.8	91.4	87.3	87.3	84.0				140.2
	10000	87.5	87.8	87.8	85.3	86.0	84.7	84.8	85.9	88.2	88.7	90.3	86.2	85.6	83.0				139.8
	12500	85.2	86.6	85.7	83.3	83.5	82.3	82.3	84.0	86.6	88.0	87.8	84.9	83.2	80.6				139.1
	16000	92.8	84.5	82.4	81.7	80.5	79.5	79.7	80.8	83.0	84.1	84.7	81.8	80.5	78.4				138.1
	20000	81.4	82.6	81.7	80.6	79.5	77.9	78.3	79.3	81.6	81.7	82.6	80.2	78.6	77.6				139.1
OVERALL MEASURED		101.4	103.3	102.1	100.9	101.0	100.3	100.6	101.2	103.3	104.5	106.0	105.5	106.6	106.1				
OVERALL CALCULATED		100.6	102.2	101.3	99.7	100.1	99.3	99.4	100.2	102.3	103.5	105.0	104.1	105.2	104.8				153.1
PNDB		115.4	117.3	116.2	114.8	115.2	114.0	113.6	113.8	115.6	117.0	118.8	116.7	117.5	115.7				

TABLE A8

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 61.1% N_{fc} ; BLEED CASING, 4% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 14 HR. 15.2

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	PWL
RADIAL 100. FT.	50		69.4	68.2	69.5	68.1	69.5	69.8	71.8	70.7	71.7	72.3	73.0	75.1	77.7	79.8	122.1
(30. M)	63		70.6	70.4	74.6	71.0	71.1	70.7	77.6	71.1	72.5	73.8	73.9	76.8	77.5	79.3	123.8
VEHICLE .5 FAN	80		68.2	71.2	72.0	70.1	67.8	69.4	70.7	71.3	71.7	72.7	74.1	75.2	76.6	78.2	122.1
CONFIG FAN B	100		70.7	73.9	72.7	71.9	71.8	71.5	70.8	70.6	71.4	71.7	73.0	73.2	74.8	74.9	121.9
LOC PTO	125		68.4	68.4	67.4	68.6	68.3	69.5	70.3	69.5	70.0	70.9	71.3	71.7	73.4	71.6	119.8
DATE 12/18/70	160		69.6	68.0	67.8	69.1	67.9	66.9	71.4	70.8	69.5	69.0	69.9	70.8	71.3	71.4	119.4
RUN 25A, PT. 356	200		66.8	65.3	68.2	65.9	69.1	67.9	67.8	68.1	69.3	69.9	71.8	73.8	75.1	75.1	119.9
TAPE S1244,	250		68.6	68.5	70.5	69.2	71.6	72.0	72.2	73.2	73.9	75.0	76.4	77.5	78.5	77.2	123.7
BAR 29.0 HG	315		70.1	72.0	72.3	72.6	72.5	73.3	76.1	76.8	77.7	78.1	78.1	79.4	79.5	76.6	126.1
(97800, N/M2)	400		72.6	74.2	72.0	73.7	72.2	74.2	74.3	75.6	77.1	77.6	77.4	76.8	76.6	75.2	125.2
TAMB 37, DEG F	500		71.8	71.2	69.5	70.8	70.6	70.4	70.5	71.5	73.4	73.7	74.4	74.3	73.8	72.7	122.1
(276, DEG K)	630		71.2	71.6	71.0	71.0	71.0	71.2	73.8	74.6	75.4	76.5	76.9	77.4	76.6	75.1	124.3
TWET 34, DEG F	800		71.2	71.2	71.0	72.0	71.2	71.5	73.0	73.5	74.8	76.6	77.2	75.1	74.7	73.4	123.9
(274, DEG K)	1000		73.3	71.3	71.7	71.2	70.7	72.7	73.8	74.3	76.1	77.9	79.0	77.7	74.8	73.3	125.1
HACT 4.36 GM/M3	1250		70.9	71.4	70.3	70.0	70.2	70.5	71.4	73.1	75.5	78.2	78.3	77.0	74.0	72.3	124.3
(.00436 KG/M3)	1600		74.5	73.8	72.1	71.7	71.8	71.1	72.6	73.9	76.7	79.5	80.0	78.7	76.0	73.4	126.0
NFA 4475, RPM	2000		86.0	84.8	81.8	82.0	80.9	78.7	79.0	80.3	81.6	83.9	85.7	85.6	85.6	82.4	133.4
(469, RAD/SEC)	2500		75.3	74.6	72.3	71.4	71.4	70.6	71.5	72.9	75.4	76.9	79.1	78.1	75.1	72.7	125.2
NFK 4573, RPM	3150		75.5	73.6	72.8	70.6	71.0	70.5	70.9	72.6	73.6	74.8	80.5	79.7	75.4	73.0	125.5
(479, RAD/SEC)	4000		84.8	83.0	82.4	78.7	76.4	77.4	76.6	77.7	77.8	81.1	84.5	83.2	83.0	79.3	131.8
NFD 7488, RPM	5000		78.0	79.0	75.5	75.6	76.3	71.3	72.6	73.7	77.3	80.1	81.6	81.2	77.2	73.6	128.5
(784, RAD/SEC)	6300		81.3	80.3	79.5	76.4	76.4	74.5	74.6	75.0	78.0	80.1	84.0	83.4	78.1	75.5	130.6
NO. BLADES 26	8000		81.1	81.5	78.8	77.2	76.2	72.4	73.2	73.8	76.2	78.3	81.2	80.3	78.0	73.5	129.9
	10000		80.2	79.0	78.6	75.8	75.7	71.0	71.5	72.3	74.5	75.3	78.9	77.6	75.4	72.0	129.0
	12500		78.2	78.4	76.5	74.0	73.9	68.6	68.4	68.8	71.6	73.4	75.5	75.3	73.5	69.8	128.1
	16000		76.9	77.4	74.3	72.9	72.0	66.8	67.1	66.8	68.9	70.3	73.1	72.9	71.6	68.6	128.2
	20000		76.1	76.3	73.7	71.6	71.1	65.8	66.7	66.4	68.3	68.9	71.5	71.5	69.9	67.7	129.8
OVERALL MEASURED			92.4	91.8	90.3	89.0	88.4	87.5	88.6	89.1	90.6	92.4	94.3	93.8	92.9	91.2	
OVERALL CALCULATED			91.9	91.3	89.7	88.3	87.8	86.5	87.6	88.0	89.6	91.4	93.4	93.0	91.9	90.1	141.4
PNDB			105.4	104.3	103.3	101.3	100.6	99.8	100.1	101.0	102.4	104.4	107.0	106.2	105.1	102.3	

TABLE A9

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 66.9% N_{fc} ; BLEED CASING, 4% BLEED RATE

PAGE 1   NASA QUIET ENGINE   1/2 SCALE FAN   PROC. DATE - MONTH 1 DAY 15 HR, 15.1

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL DIS. FT.	50		72.7	70.3	72.7	72.7	71.9	72.3	73.8	72.4	73.9	74.1	75.2	77.2	80.1	83.1			124.6
(30. M)	63		71.4	71.7	76.2	73.2	72.9	73.2	78.2	72.8	74.1	74.6	75.5	78.4	80.0	82.7			125.5
VEHICLE .5 FAN	80		72.9	75.1	80.4	75.5	77.0	78.4	77.8	80.5	81.1	77.6	75.1	77.4	79.0	81.8			128.1
CONFIG FAN B	100		69.7	74.1	77.6	77.2	75.9	75.6	72.8	73.4	74.8	74.5	75.2	76.2	77.6	78.4			125.2
LOC PT	125		68.7	69.0	69.0	69.9	69.0	69.9	70.6	70.5	71.7	72.6	73.3	73.9	75.8	74.8			121.3
DATE 12/18/70	160		71.2	69.3	68.6	68.9	70.5	69.9	69.5	69.6	74.6	71.0	71.9	76.8	75.6	76.2			121.9
RUN 25A, PT. 358	200		65.4	66.6	68.1	67.5	68.7	69.2	70.3	70.1	72.0	72.7	74.6	76.7	78.6	78.6			122.4
TAPE S1244.	250		69.3	70.8	72.0	72.5	73.5	74.5	75.9	76.2	76.7	77.6	79.3	80.6	81.8	80.5			126.6
BAR 29.0 HG	315		71.5	73.9	74.4	75.1	75.1	76.8	77.3	78.5	79.5	80.2	80.9	81.8	82.3	80.1			128.3
(97800, N/M2)	400		73.6	75.5	74.1	74.1	73.4	74.9	75.8	77.3	78.7	79.5	79.8	79.3	78.9	77.8			127.0
TAMB 37, DEG F	500		72.8	73.1	71.6	71.2	71.4	71.0	71.5	72.9	74.1	75.2	76.1	77.0	76.4	75.1			123.7
(276, DEG K)	630		71.8	73.0	72.4	71.6	73.0	74.2	76.3	77.3	78.5	79.5	79.8	80.4	79.0	77.2			127.0
TWET 34, DEG F	800		72.6	73.3	72.6	72.9	72.9	73.1	74.6	75.3	76.6	78.3	79.1	77.4	76.6	75.6			125.7
(274. DEG K)	1000		73.7	73.8	72.6	72.4	72.4	73.7	75.4	76.8	78.6	80.0	81.5	79.8	77.1	75.8			127.2
HACT 4.36 GM/M3	1250		72.4	74.0	72.7	72.0	72.3	72.2	73.8	75.5	77.5	80.2	80.8	78.7	76.1	74.7			126.5
(.00435 KG/M3)	1600		74.7	75.1	73.7	73.1	73.4	73.0	74.5	75.9	78.4	81.2	81.8	79.6	77.1	75.1			127.5
NFA 4905, RPM	2000		86.3	87.8	84.9	83.6	82.7	81.0	81.3	82.7	83.8	86.0	88.4	86.8	88.2	86.3			135.6
(514, RAD/SEC)	2500		79.4	80.2	77.7	76.3	75.8	74.6	75.4	76.7	78.7	80.1	83.1	81.2	80.6	78.4			129.3
NFK 5013, RPM	3150		75.9	75.6	74.6	72.3	73.0	72.7	73.4	75.3	75.9	76.9	82.6	81.6	76.9	75.1			127.5
(525, RAD/SEC)	4000		86.8	88.5	85.7	82.7	79.4	80.5	79.9	80.8	81.4	84.2	87.5	84.8	83.9	81.0			134.9
NFD 7488, RPM	5000		80.3	82.6	77.1	78.7	78.5	74.8	75.9	76.8	80.2	83.0	84.3	82.0	79.6	76.5			131.2
(784, RAD/SEC)	6300		83.2	82.4	82.6	79.1	77.8	77.9	78.2	78.3	81.0	82.7	86.6	84.4	80.3	78.3			133.0
NO. BLADES 26	8000		81.5	83.9	80.9	79.7	77.8	75.5	76.2	76.9	79.5	80.9	83.7	81.6	79.8	75.9			132.1
	10000		81.3	81.7	80.4	78.2	76.9	74.3	74.6	75.4	77.3	77.8	81.5	79.1	77.8	74.4			131.2
	12500		78.9	80.7	78.3	76.2	75.1	72.1	72.0	72.1	74.8	75.9	78.1	76.8	75.9	71.9			130.2
	16000		77.8	79.8	76.2	75.7	73.4	70.6	70.3	70.2	72.4	72.9	76.0	74.6	74.2	71.0			130.5
	20000		77.2	78.5	75.9	74.7	72.9	69.9	69.9	69.7	72.2	71.7	74.4	73.4	72.7	70.4			132.2
OVERALL MEASURED			93.7	95.1	93.3	91.7	90.7	90.5	91.2	91.9	93.5	94.8	96.8	95.7	95.4	94.5			
OVERALL CALCULATED			93.2	94.5	92.6	90.9	89.9	89.4	90.0	90.9	92.4	93.9	96.0	94.7	94.3	93.3			143.9
PNDB			107.0	108.4	106.3	104.2	102.7	102.7	102.9	103.8	105.2	107.2	109.8	108.0	107.5	105.7			

TABLE A10

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 81.9% N_{fc} ; BLEED CASING, 4% BLEED RATE

PAGE 1 NASA QUIET E.[illegible] 1/2 SCALE FAN. PROC. DATE - MONTH 1 DAY 15 HR. 15.1

REL S.[illegible] PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50		75.3	73.3	75.3	74.5	74.9	76.0	77.7	77.4	78.9	79.7	80.9	83.6	87.9	90.6			130.6
(30.5 M)	63		73.5	74.5	77.2	75.3	75.3	76.0	79.8	77.6	79.3	80.4	81.3	84.2	87.9	90.7			131.0
VEHICLE .5 FAN	80		72.7	73.8	74.7	73.7	74.5	76.1	77.2	78.0	79.1	80.3	81.2	83.8	87.4	89.4			130.3
CONFIG FAN B	100		78.4	79.2	78.3	77.3	80.4	84.4	85.1	84.6	81.7	82.8	82.6	83.8	86.7	86.3			132.7
LOC FTO	125		73.1	74.1	73.9	73.4	74.5	75.6	76.1	76.6	78.3	79.3	79.7	80.6	83.2	81.8			127.5
DATE 12/13/7[illegible]	160		71.0	71.4	71.0	72.4	72.1	73.1	73.4	74.3	76.5	77.2	78.5	79.9	82.2	82.0			126.1
RUN 25A, PT. 36[illegible]	200		73.2	74.5	75.9	75.7	75.3	76.2	77.5	76.3	78.1	80.9	83.1	85.9	87.2	86.6			130.5
TAPE S1244,	250		74.0	75.5	76.9	76.2	77.8	79.1	80.3	81.3	82.7	84.5	86.6	88.6	90.3	88.7			133.5
BAR 29.0 HG	315		77.2	79.7	79.9	79.1	80.3	81.8	83.0	84.8	86.0	87.1	88.2	89.6	90.3	88.0			135.2
(97800, N/M2)	400		78.5	80.2	78.7	78.9	79.5	81.2	81.8	83.4	85.6	86.1	86.4	87.0	87.2	85.3			133.6
TAMB 37. DEG F	500		76.8	76.1	76.0	76.2	76.6	77.0	77.5	78.6	80.5	81.9	82.8	84.4	83.9	81.8			129.9
(276, DEG K)	630		76.2	77.4	76.4	77.1	78.8	80.2	82.6	83.6	85.4	86.4	86.2	86.7	85.8	83.8			133.3
TWET 34. DEG F	800		76.3	77.0	76.8	77.7	78.3	79.2	80.9	81.9	83.2	84.6	85.1	83.3	82.5	81.0			131.6
(274, DEG K)	1000		75.9	77.1	76.4	76.7	77.4	78.4	80.2	81.6	83.1	84.6	85.8	83.8	82.2	80.4			131.6
HACT 4.36 GM/M3	1250		75.3	75.9	75.7	76.1	77.1	77.1	78.2	79.7	81.8	83.8	84.1	82.4	80.5	78.9			130.3
(.00436 KG/M3)	1600		76.7	76.9	77.3	76.5	77.5	77.4	78.5	79.9	81.8	84.3	84.4	82.2	80.5	78.7			130.7
NFA 6[illegible]. RPM	2000		78.2	79.3	79.0	77.5	77.9	78.2	79.2	80.6	82.2	84.5	85.6	82.5	80.9	79.1			131.5
(628, RAD/SEC)	2500		94.5	94.3	93.5	92.9	91.7	88.8	87.2	86.6	88.2	90.6	93.2	90.7	91.6	89.0			141.9
NFK 6131, RPM	3150		81.6	81.7	80.9	79.6	79.5	78.4	78.3	79.8	80.3	82.3	86.1	84.6	81.3	78.9			132.1
(642, RAD/SEC)	4000		82.0	81.7	81.4	79.2	78.1	80.2	81.1	82.9	83.5	86.4	87.4	84.7	82.6	80.0			133.9
NFD 7458, RPM	5000		86.4	90.0	86.2	87.8	89.0	92.6	82.4	83.2	87.4	89.6	89.7	86.6	87.1	83.1			138.2
(784, RAD/SEC)	6300		82.1	82.1	81.6	79.9	80.3	80.4	81.7	82.6	85.5	87.3	89.1	85.4	82.1	79.9			135.4
NO. BLADES 25	8000		85.2	87.4	85.5	84.5	83.6	81.3	81.9	82.6	85.1	86.9	88.4	84.6	84.4	80.2			136.9
	10000		82.4	83.0	82.9	80.8	80.5	78.9	79.6	80.6	82.4	83.3	85.7	81.8	80.7	77.4			134.7
	12500		73.9	80.9	79.6	77.7	78.3	76.0	76.2	77.3	79.7	81.2	82.2	79.5	77.4	74.1			133.0
	16000		77.0	77.4	75.9	76.9	75.9	73.9	74.1	74.5	76.5	78.1	79.7	77.1	74.8	72.2			132.6
	20000		76.0	77.7	76.1	75.3	74.6	72.3	72.7	73.4	75.3	76.1	77.8	75.6	73.1	71.2			133.7
OVERALL MEASURED			97.9	99.0	97.5	97.1	97.0	95.7	96.1	96.8	98.4	100.1	101.3	100.5	101.3	100.5			
OVERALL CALCULATED			97.1	98.0	96.6	96.1	96.0	94.6	95.0	95.7	97.3	99.1	100.4	99.3	100.0	99.2			148.4
PNDB			111.8	112.5	111.4	110.8	110.3	106.7	108.4	108.7	110.4	112.5	114.3	112.5	112.7	110.1			

TABLE A11

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 93.4% N_{fc} ; BLEED CASING, 4% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 14 HR. 15.2

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50	77.8	76.9	77.2	77.2	77.3	79.3	79.9	80.8	82.2	82.6	84.2	87.4	91.9	95.2				134.4
(30. M)	63	78.4	77.5	78.5	78.5	78.6	79.1	81.4	81.2	82.7	83.5	85.2	88.3	92.7	95.9				135.2
VEHICLE .5 FAN	80	76.3	77.0	77.7	77.2	77.7	79.2	80.5	81.4	82.9	84.0	85.4	88.3	92.4	94.7				134.8
CONFIG FAN B	100	78.1	77.8	79.3	78.1	79.8	81.1	81.7	82.1	83.6	84.1	86.0	88.5	91.9	92.1				134.5
LOC PTO	125	78.7	78.6	77.9	77.9	78.4	79.9	81.4	81.4	83.9	83.9	85.6	86.1	88.7	87.1				132.7
DATE 12/18/70	160	75.9	76.2	74.6	76.3	76.1	76.9	77.2	78.2	80.5	81.3	83.3	84.7	87.8	87.3				130.8
RUN 25A, PT. 374	200	76.5	75.5	76.7	76.3	77.6	78.1	79.6	80.4	82.7	84.5	87.3	90.5	92.7	91.5				134.8
TAPE S1245.	250	79.1	79.7	81.6	80.8	82.6	83.3	84.7	85.5	87.2	89.2	91.9	94.1	95.6	93.9				138.6
BAR 28.9 HG	315	82.3	84.4	83.4	84.5	85.0	85.6	87.4	88.4	90.2	92.1	93.8	95.2	95.8	93.9				140.2
(97713, N/M2)	400	82.4	84.4	82.4	83.1	83.6	84.9	86.2	87.8	89.4	90.6	91.4	91.9	92.0	90.6				138.1
TAMB 37, DEG F	500	81.8	81.9	80.6	80.1	81.0	80.9	81.9	83.4	85.2	86.7	88.2	90.0	89.4	87.6				135.1
(276, DEG K)	630	80.5	80.1	80.3	80.6	82.3	84.1	86.2	87.7	89.3	90.7	91.2	92.0	90.8	88.6				137.8
THET 34, DEG F	800	79.6	81.0	81.7	82.1	82.3	83.5	85.2	86.4	87.7	89.2	89.6	88.5	87.8	86.3				136.2
(274, DEG K)	1000	81.0	81.6	82.8	82.8	82.1	83.2	84.7	86.5	88.5	90.2	91.3	89.1	87.6	86.4				136.9
HACT 4.51 GM/M3	1250	80.4	82.7	83.5	83.9	83.7	82.3	83.1	84.5	86.6	88.2	89.4	87.4	86.0	85.0				135.6
(.00451 KG/M3)	1600	83.1	84.2	83.9	83.2	83.3	82.6	83.3	85.2	86.5	88.4	89.3	87.4	86.3	86.2				135.9
NFA 6840. RPM	2000	83.5	84.5	84.6	82.9	83.1	82.7	83.6	85.1	86.5	88.5	89.9	86.6	85.8	84.7				136.1
(716, RAD/SEC)	2500	85.7	87.8	86.7	86.3	86.6	84.5	84.4	84.7	87.0	88.7	90.5	86.5	87.4	85.2				137.4
NFK 6993, RPM	3150	94.3	96.4	95.1	94.7	95.1	92.3	91.0	89.6	91.9	94.1	94.6	93.0	95.0	92.0				144.4
(732, RAD/SEC)	4000	86.6	88.3	88.4	86.0	84.3	85.9	85.9	86.6	87.2	89.3	90.2	87.0	87.5	85.0				138.2
NFD 7488, RPM	5000	85.2	87.7	86.4	86.1	86.6	83.5	84.2	84.6	88.1	90.3	88.8	85.6	85.3	82.5				137.7
(784, RAD/SEC)	6300	90.7	90.9	91.5	88.4	89.0	89.0	87.8	88.0	91.5	92.4	95.0	90.8	88.4	87.0				142.0
NO, BLADES 26	8000	84.9	87.7	86.7	85.7	85.7	84.2	84.5	85.1	88.1	89.6	90.9	86.5	85.6	82.5				138.9
	10000	83.9	85.5	85.5	83.5	84.3	82.7	83.1	83.8	86.2	86.8	89.0	84.7	83.1	81.1				137.9
	12500	80.8	83.6	82.7	80.9	81.6	80.0	80.6	82.2	84.4	85.7	86.3	82.9	80.7	78.6				136.9
	16000	78.3	81.2	79.0	78.7	78.1	76.9	77.5	78.4	80.7	82.1	83.4	80.2	78.0	76.6				135.7
	20000	76.8	78.9	77.6	76.7	76.3	74.7	75.6	76.9	78.9	79.6	81.1	78.5	75.9	75.6				136.3
	OVERALL MEASURED	99.7	101.3	100.6	99.9	100.2	99.3	99.7	100.4	102.3	103.9	105.2	104.9	106.1	105.7				
	OVERALL CALCULATED	98.8	100.4	99.9	99.0	99.3	98.3	98.7	99.3	101.4	103.0	104.2	103.6	104.7	104.3				152.0
	PNDB	113.9	115.6	114.9	114.3	114.6	113.0	112.7	112.6	114.8	116.6	117.6	116.1	117.1	115.1				

TABLE A12

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 61.8% N_{fc} ; BLEED CASING, 2% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 15 HR, 16.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	PWL
RADIAL 100, FT.	50	71,2	69,3	68,6	69,6	68,4	68,6	69,2	70,4	70,1	71,7	71,9	72,2	73,9	76,5	78,4	121,3
(30. M)	63	68,1	68,6	69,5	73,6	70,9	68,6	68,7	74,4	70,1	71,3	71,6	72,9	74,7	76,7	78,3	122,2
VEHICLE .5 FAN	80	68,1	70,1	70,8	73,7	69,6	68,5	68,9	70,5	71,9	72,8	72,9	74,5	75,1	75,3	76,9	122,1
CONFIG FAN B	100	75,6	73,9	72,9	71,4	71,7	74,1	69,9	69,8	70,1	73,8	74,8	72,7	73,9	74,2	74,4	122,6
LOC PTO	125	66,7	67,4	67,8	67,9	68,2	68,2	69,5	69,0	67,7	68,3	69,0	69,5	69,8	71,8	69,7	118,6
DATE 12/28/70	160	68,6	68,9	66,5	68,5	66,7	69,8	66,7	67,1	66,1	67,6	68,3	72,3	70,8	73,7	73,6	119,1
RUN 268. PT. 423	200	66,0	67,8	66,4	68,6	67,7	70,2	70,1	68,8	70,8	72,0	72,0	73,7	75,5	76,9	76,3	121,6
TAPE S1253.	250	66,8	68,6	69,7	70,9	69,7	71,3	72,7	72,6	74,6	75,3	76,0	76,8	77,4	78,9	77,1	124,3
BAR 28.9 HG	315	69,4	69,8	72,5	71,7	72,3	71,8	73,1	75,5	76,4	76,5	78,1	77,9	77,7	78,3	75,3	125,4
(97540, N/M2)	400	71,2	72,6	74,1	72,3	72,9	72,3	73,4	72,4	74,5	74,8	75,6	76,0	75,4	73,9	73,3	124,0
TAMB 24, DEG F	500	71,2	72,7	71,4	70,1	70,3	72,4	70,8	70,6	70,7	71,4	72,9	74,2	73,8	73,9	71,4	122,0
(268, DEG K)	630	69,5	71,6	71,5	70,8	73,5	72,9	71,2	73,2	74,5	76,1	76,5	76,8	76,7	75,8	74,8	124,4
TWET 21, DEG F	800	68,8	70,5	70,8	70,3	71,3	70,8	71,0	71,0	71,5	73,6	74,9	75,5	74,0	73,5	71,9	122,6
(267, DEG K)	1000	68,5	70,7	71,5	70,3	70,6	70,0	70,9	71,4	72,8	75,0	76,8	77,7	76,5	74,0	72,5	123,8
HACT 2.41 GM/M3	1250	68,0	70,7	71,0	70,3	69,9	69,6	69,8	70,1	72,1	73,8	76,9	77,1	76,0	73,6	71,2	123,3
(.00241 KG/M3)	1600	71,0	74,5	74,0	72,7	71,6	71,5	71,2	71,2	73,3	75,0	78,4	79,0	78,0	76,5	73,5	125,3
NFA 4470, RPM	2000	82,4	86,1	86,2	84,0	82,2	81,8	79,6	78,8	80,6	81,8	84,2	86,5	86,5	88,4	84,7	134,4
(468, RAD/SEC)	2500	68,8	74,3	73,8	72,4	71,1	70,7	69,7	70,5	72,6	74,2	76,5	78,0	77,9	75,1	72,2	124,6
NFK 4631, RPM	3150	68,0	75,8	76,4	74,2	70,6	70,6	70,5	70,1	72,7	74,6	74,1	80,1	78,5	75,3	72,7	125,4
(485, RAD/SEC)	4000	78,1	85,8	87,1	85,9	80,4	77,7	78,9	76,1	79,4	81,1	81,1	85,3	85,8	85,3	81,1	133,8
NFD 7488, RPM	5000	69,7	77,5	78,9	76,7	76,2	75,9	72,0	73,6	74,4	76,0	80,5	82,3	81,0	77,7	73,2	128,7
(784. RAD/SEC)	6300	72,9	83,2	83,9	82,2	77,6	77,5	76,4	74,6	77,3	79,2	81,5	84,1	84,6	80,0	76,6	132,1
NO. BLADES 26	8000	72,2	81,9	83,3	80,8	79,5	77,8	74,8	75,2	76,8	78,5	79,8	83,1	81,6	80,5	74,9	131,7
	10000	71,1	82,4	82,1	81,3	78,3	77,9	74,6	73,5	76,4	78,7	79,0	81,5	80,0	78,7	74,3	131,8
	12500	69,6	80,9	81,7	79,7	77,7	77,0	73,2	71,8	73,5	75,4	76,9	78,9	78,3	77,7	73,0	131,4
	16000	67,6	79,5	80,2	77,5	76,4	74,7	71,2	69,9	69,9	72,7	73,8	76,5	76,0	76,0	72,1	131,4
	20000	67,0	79,1	79,9	77,2	75,7	74,3	70,3	69,2	69,7	72,2	73,2	75,6	75,2	75,1	72,1	133.5
OVERALL MEASURED		87,7	93,0	93,6	92,1	89,8	89,2	88,0	87,8	89,3	90,8	92,3	94,3	94,1	94,0	91,5	
OVERALL CALCULATED		86,9	92,9	93,5	91,9	89,5	88,8	87,4	87,1	88,6	90,2	91,7	93,9	93,7	93,4	90,6	142.9
PNDB		100.2	106.0	106.9	105.7	102.1	101.3	100.7	99.6	101.9	103.5	104.5	107.4	107.4	106.6	103.4	

TABLE A13

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 94.9% N_{fc} ; BLEED CASING, 2% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 15 HR. 16.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	PWL
RADIAL 100. FT.	50	77.7	76.3	76.4	77.6	77.5	77.7	79.1	79.6	80.9	82.3	83.2	84.6	88.1	92.5	95.9	134.9
(30. M)	63	77.0	77.2	77.5	79.2	77.9	78.2	79.3	81.1	81.4	82.7	83.7	85.2	88.6	93.1	96.2	135.4
VEHICLE .5 FAN	80	73.0	75.5	76.1	77.7	76.8	77.4	79.3	80.1	81.2	82.5	83.5	85.2	88.2	92.1	94.4	134.4
CONFIG FAN B	100	75.7	78.8	77.2	78.7	77.7	78.0	80.0	80.7	81.5	83.2	83.5	85.1	87.4	91.1	91.1	133.6
LOC PTO	125	75.7	77.4	78.3	78.0	78.6	77.6	79.9	81.1	81.1	83.6	82.2	83.5	85.0	87.0	86.2	131.7
DATE 12/28/70	160	74.5	74.5	74.8	73.9	75.4	75.0	76.1	76.2	78.3	80.1	81.7	84.2	86.6	89.8	89.4	131.9
RUN 263. PT. 425	200	74.2	75.8	75.7	77.6	77.2	78.4	80.3	81.6	83.0	84.7	86.4	89.0	92.3	94.7	93.2	136.6
TAPE S1253.	250	76.9	79.4	81.5	83.0	81.6	82.4	84.9	85.5	87.1	88.5	90.5	92.3	94.4	96.5	94.6	139.3
BAR 28.9 HG	315	82.2	82.1	84.4	83.4	83.9	84.2	86.0	86.7	88.0	89.5	91.8	93.2	94.1	95.1	93.2	139.6
(97540. N/M2)	400	81.7	82.6	83.1	82.2	83.1	82.7	83.7	83.9	86.0	87.2	88.7	89.9	90.1	89.7	88.7	136.4
TAMB 24. DEG F	500	80.0	81.1	79.8	80.2	80.4	80.9	81.0	80.9	82.9	84.3	86.7	88.5	90.0	89.8	86.6	134.9
(268. DEG K)	630	77.7	80.1	80.2	80.9	81.6	82.1	84.6	85.2	87.1	88.9	90.3	90.7	91.0	89.9	87.9	137.2
TWET 21. DEG F	800	78.2	80.1	81.8	82.6	82.6	82.7	83.2	83.4	84.4	86.8	88.2	88.9	87.8	87.0	85.3	135.4
(267. DEG K)	1000	78.8	80.0	82.3	83.3	82.7	83.1	82.8	83.7	85.7	87.9	89.4	90.4	88.8	87.2	86.1	136.4
HACT 2.41 GM/M3	1250	77.9	81.7	82.6	84.3	83.2	82.8	82.0	82.5	83.8	85.7	87.9	88.8	87.3	85.6	84.3	135.2
(.00241 KG/M3)	1600	78.7	83.5	84.6	86.0	83.1	85.3	82.8	82.0	84.2	85.9	87.8	88.4	87.0	85.6	84.6	135.7
NFA 6860. RPM	2000	78.8	83.5	85.8	85.0	82.5	82.9	83.1	82.5	84.9	86.1	88.5	89.5	86.4	85.7	84.5	135.9
(718. RAD/SEC)	2500	81.1	89.2	89.9	88.1	87.4	87.9	84.6	84.9	85.4	86.3	89.2	90.2	86.9	87.6	85.7	138.1
NFK 7108. RPM	3150	89.0	98.6	99.9	97.1	96.1	97.0	92.3	92.4	91.5	92.4	93.9	96.3	93.8	95.6	93.6	146.1
(744. RAD/SEC)	4000	81.9	88.4	90.1	90.2	87.8	86.8	87.4	85.5	87.5	88.8	88.9	90.1	88.2	88.4	85.5	139.2
NFD 7488. RPM	5000	78.9	86.8	80.6	87.3	88.1	87.9	85.2	85.9	85.7	87.3	91.1	89.6	85.6	86.3	83.0	138.6
(784. RAD/SEC)	6300	84.2	94.3	95.5	93.6	89.7	90.5	90.7	87.9	90.9	93.8	94.5	95.2	91.6	90.1	88.8	143.9
NO. BLADES 26	8000	79.3	88.8	90.4	89.4	88.4	88.3	86.6	86.8	88.0	89.7	90.8	92.5	87.9	87.6	84.4	141.0
	10000	78.5	88.5	89.5	89.0	87.0	87.6	86.2	85.9	87.9	89.3	90.0	91.5	87.4	86.3	83.7	141.1
	12500	77.0	86.8	88.5	87.4	85.6	86.2	84.7	84.6	87.0	86.3	89.5	90.2	86.7	85.2	82.1	141.2
	16000	74.2	84.4	86.3	84.4	83.8	83.1	82.1	82.3	82.4	85.4	86.2	87.1	84.0	82.9	79.9	140.2
	20000	72.8	82.9	84.9	83.4	82.3	81.7	80.7	81.0	81.7	83.9	84.9	85.8	83.0	81.1	79.8	141.5
	OVERALL MEASURED	95.4	102.3	103.6	102.0	100.9	101.3	99.9	99.7	100.9	102.6	104.1	105.3	104.9	106.2	105.8	
	OVERALL CALCULATED	94.5	102.1	103.4	101.7	100.4	100.9	99.3	99.1	100.3	102.0	103.4	104.6	103.8	105.0	104.6	153.4
	PNDB	109.3	117.0	118.3	116.5	115.4	116.1	113.6	113.4	113.8	115.2	116.7	118.3	116.5	117.5	115.8	

TABLE A14

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

100'(30.5 M) ARC ; 61.7% N_{fc} ; BLEED CASING, 3% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 15 HR. 16.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50	71.4	69.5	68.7	69.7	68.5	68.6	69.4	70.3	70.4	71.6	71.6	72.7	74.7	76.6	78.6			121.5
(30. M)	63	69.3	69.7	69.8	74.0	70.2	69.1	69.3	74.3	70.6	72.0	72.7	73.5	75.6	76.3	78.5			122.5
VEHICLE .5 FAN	80	68.2	69.6	70.6	73.4	69.3	68.1	69.3	70.9	73.0	73.4	73.1	74.9	75.5	75.3	77.0			122.4
CONFIG FAN B	100	75.5	73.7	72.9	71.3	71.5	74.1	69.9	69.9	70.2	73.3	74.7	73.2	73.9	74.0	74.4			122.6
LOC PTO	125	67.4	67.4	68.1	68.0	68.3	68.5	69.5	69.0	67.5	68.7	69.3	69.0	69.8	71.7	70.2			118.7
DATE 12/28/70	160	67.6	67.7	66.8	69.0	66.9	69.8	67.1	67.4	66.1	68.0	68.1	70.7	70.3	73.2	73.6			118.8
RUN 268. PT. 424	200	66.0	67.1	66.3	68.1	67.5	70.3	69.9	69.0	70.8	72.1	72.0	73.5	75.2	76.5	76.1			121.5
TAPE S1253.	250	66.7	67.9	69.4	70.4	69.6	71.3	72.6	72.9	74.8	75.4	76.1	76.8	77.6	78.8	77.1			124.3
BAR 28.9 HG	315	69.3	69.8	72.5	71.3	72.3	71.8	73.2	75.4	76.4	76.7	78.3	78.0	77.9	78.2	75.6			125.4
(97540. N/M2)	400	71.1	72.5	74.2	72.4	73.1	72.2	73.5	72.5	74.6	74.8	75.7	75.9	75.4	73.7	73.3			124.0
TAMB 24. DEG F	500	71.2	72.5	71.3	69.8	70.5	72.4	70.9	70.5	70.8	71.6	73.0	74.0	73.9	73.6	71.4			122.0
(268. DEG K)	630	69.9	71.9	71.6	71.0	73.5	72.7	71.2	73.5	74.4	76.2	76.6	76.8	76.6	75.5	74.8			124.5
TWET 21. DEG F	800	68.8	70.4	71.1	70.4	71.8	71.0	71.3	71.0	71.6	73.7	74.8	75.4	74.0	73.2	72.1			122.6
(267. DEG K)	1000	68.6	70.8	71.6	70.4	70.7	70.2	70.9	71.6	73.1	75.1	76.8	77.6	76.6	73.5	72.8			123.9
HACT 2.41 GM/M3	1250	67.9	70.5	70.9	70.4	70.1	69.7	70.0	70.3	72.3	73.9	76.9	76.9	76.2	73.0	71.4			123.4
(.00241 KG/M3)	1600	70.8	73.9	73.7	72.5	71.5	71.5	71.2	71.3	73.2	75.1	78.4	78.5	77.7	75.5	73.6			125.1
NFA 4460. RPM	2000	81.5	84.8	85.3	83.1	81.5	81.2	79.2	78.5	79.8	81.4	83.4	85.8	85.3	86.9	84.3			133.5
(467. RAD/SEC)	2500	68.4	73.6	73.5	72.3	71.0	70.7	69.8	70.5	72.5	74.1	76.5	77.5	77.5	74.3	72.1			124.3
NFK 4621. RPM	3150	67.7	74.9	75.7	73.7	70.4	70.5	70.4	70.1	72.7	74.6	74.1	79.6	78.2	74.5	72.6			125.1
(484. RAD/SEC)	4000	76.9	83.5	85.9	84.6	79.4	76.8	78.1	75.8	79.0	80.7	80.7	84.3	84.7	83.8	80.3			132.7
NFD 7488. RPM	5000	69.3	76.3	78.0	76.0	75.9	75.6	71.5	73.5	74.3	75.8	80.3	81.7	80.6	77.0	73.1			128.2
(784. RAD/SEC)	6300	72.2	81.8	82.7	81.0	76.9	76.6	75.5	74.2	76.9	78.9	81.1	83.4	83.9	78.9	76.2			131.3
NO. BLADES 26	8000	71.3	80.4	82.2	80.0	78.7	77.1	74.0	74.8	76.2	77.9	79.2	82.3	81.0	79.4	74.6			130.9
	10000	70.6	81.0	81.4	80.7	77.8	77.2	73.8	73.2	75.8	77.8	78.3	80.7	79.4	77.8	74.2			131.0
	12500	69.4	79.7	81.0	79.3	77.2	76.5	72.5	71.5	73.1	74.8	76.4	76.2	77.8	77.1	73.0			130.8
	16000	67.5	78.5	79.8	77.4	76.2	74.4	70.6	69.7	69.6	72.3	73.5	75.8	75.6	75.5	72.2			131.0
	20000	67.0	78.2	79.5	77.3	75.6	74.2	69.9	69.2	69.6	71.9	73.0	75.0	75.0	74.8	72.3			133.1
OVERALL MEASURED		87.3	91.7	92.8	91.4	89.3	88.8	87.7	87.8	89.1	90.6	92.1	93.8	93.6	93.1	91.4			
OVERALL CALCULATED		86.4	91.6	92.7	91.2	89.0	88.4	87.0	87.0	88.4	90.0	91.5	93.3	93.1	92.4	90.4			142.3
PNDB		99.6	104.5	106.0	104.7	101.6	100.9	100.2	99.4	101.6	103.3	104.2	106.7	106.7	105.5	103.2			

TABLE A15

QEP SCALE MODEL FAN B

1/3 OCTAVE DATA CORRECTED TO STANDARD DAY

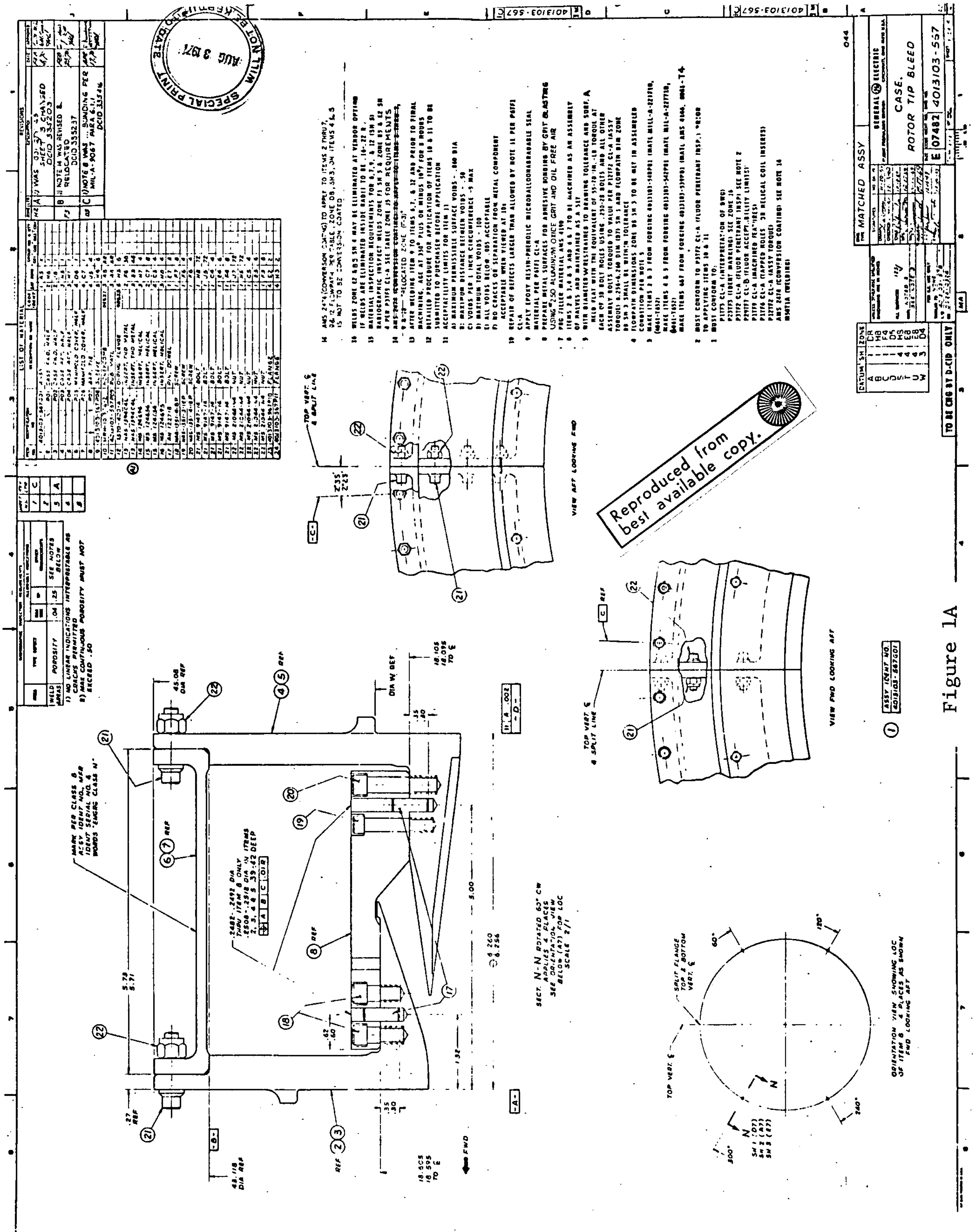
100'(30.5 M) ARC ; 94.5% N_{fc} ; BLEED CASING, 3% BLEED RATE

PAGE 1 NASA QUIET ENGINE 1/2 SCALE FAN PROC. DATE - MONTH 1 DAY 15 HR. 16.4

MODEL SOUND PRESSURE LEVELS PRESENTED FOR STANDARD DAY - ANGLES FROM INLET IN DEGREES (AND RADIANS)

	FREQ.	20. (0.35)	30. (0.52)	40. (0.70)	50. (0.87)	60. (1.05)	70. (1.22)	80. (1.40)	90. (1.57)	100. (1.75)	110. (1.92)	120. (2.09)	130. (2.27)	140. (2.44)	150. (2.62)	160. (2.79)	( )	( )	PWL
RADIAL 100. FT.	50	78.2	77.0	76.5	77.6	77.6	77.6	79.3	80.0	81.0	82.8	83.4	84.6	87.9	92.4	96.1			135.0
(30. M)	63	78.6	78.1	77.4	79.6	78.2	79.2	79.4	81.1	81.4	82.8	84.0	85.8	88.9	92.9	96.2			135.5
VEHICLE .5 FAN	80	74.4	76.0	76.3	77.7	76.9	77.7	79.5	80.0	81.6	82.7	83.8	85.4	88.3	91.9	94.0			134.4
CONFIG FAN B	100	76.0	77.9	77.3	78.7	77.6	78.1	80.4	80.7	81.7	83.0	83.4	85.0	87.6	91.2	91.0			133.6
LOC PTO	125	77.0	76.9	78.0	77.3	77.7	77.2	79.3	80.0	80.8	82.9	82.1	83.6	84.9	87.0	86.2			131.4
DATE 12/28/70	160	75.3	74.5	74.7	73.8	75.4	75.0	76.0	76.1	78.3	80.0	81.4	84.4	86.7	89.8	89.6			131.9
RUN 26B. PT. 426	200	75.0	76.0	75.8	77.5	77.2	78.5	80.0	81.4	82.9	85.0	86.3	89.1	92.3	94.7	93.3			136.6
TAPE S1253.	250	78.1	79.7	81.4	82.7	81.3	82.5	84.6	85.4	87.1	88.6	90.5	92.5	94.7	96.5	94.6			139.4
BAR 28.9 HG	315	82.6	82.1	84.1	82.9	83.6	84.2	85.6	86.5	88.1	89.7	91.8	93.2	94.2	95.2	93.2			139.6
(97540. N/M2)	400	82.3	82.5	82.8	82.1	82.8	82.5	83.7	83.7	86.1	87.5	88.9	90.1	90.1	89.2	88.4			136.5
TAMB 24. DEG F	500	80.4	81.0	79.7	79.8	80.2	80.9	80.9	81.0	83.0	84.4	86.6	88.3	90.1	89.9	86.7			134.9
(268. DEG K)	630	78.6	79.7	80.9	81.2	81.8	82.2	84.7	85.3	87.4	88.9	90.4	90.8	91.3	89.8	88.1			137.3
TWET 21. DEG F	800	78.9	80.3	81.7	82.0	82.4	82.6	83.3	83.4	84.6	86.8	88.1	88.9	88.0	87.1	85.5			135.4
(267. DEG K)	1000	79.3	79.8	81.4	82.1	82.6	82.9	82.8	83.6	86.0	87.9	89.6	90.5	88.8	87.1	86.0			136.4
HACT 2.41 GM/M3	1250	78.3	81.1	83.7	83.6	83.4	82.4	81.9	82.6	83.6	85.7	87.9	89.1	87.4	85.8	84.3			135.3
(.0024. KG/M3)	1600	79.6	81.8	83.0	85.3	82.3	84.9	82.8	82.1	83.9	85.6	87.9	88.6	87.1	85.4	84.3			135.4
NFA 6830. RPM	2000	79.6	82.6	85.3	84.1	82.3	82.8	83.2	82.4	84.9	86.0	88.4	89.6	86.6	85.4	83.9			135.8
(715. RAD/SEC)	2500	80.9	88.1	88.4	87.6	86.6	87.6	83.9	84.8	85.4	86.1	89.0	90.1	86.6	86.8	85.1			137.6
NFK 7076. RPM	3150	89.1	97.7	98.0	96.9	94.8	96.8	91.4	92.2	91.8	91.9	93.1	95.6	93.2	93.8	92.6			145.3
(741. RAD/SEC)	4000	81.1	87.3	89.2	89.9	87.0	85.5	86.9	85.1	87.5	88.7	89.1	89.9	87.9	87.6	84.9			138.7
NFD 7488. RPM	5000	78.3	85.4	87.8	86.2	87.5	87.7	84.7	85.7	85.6	87.1	91.2	89.5	85.4	85.7	82.3			139.2
(784. RAD/SEC)	6300	83.3	92.3	94.7	92.4	88.8	89.4	90.2	87.2	90.7	93.1	94.1	94.6	91.4	89.5	87.6			143.1
NO. BLADES 26	8000	78.4	87.3	89.6	88.8	87.8	87.7	86.5	86.6	87.7	89.3	90.9	92.3	87.5	86.9	83.5			140.6
	10000	77.7	87.1	88.6	88.4	86.3	86.9	85.8	85.5	87.5	88.8	89.8	91.2	86.8	85.2	82.8			140.5
	12500	76.0	85.3	87.4	86.7	84.8	85.7	84.4	84.2	86.4	87.7	89.2	89.7	86.1	84.2	81.0			140.5
	16000	73.3	83.0	85.2	83.7	83.1	82.4	81.7	81.9	82.1	85.0	85.9	86.8	83.6	81.8	79.0			139.7
	20000	72.1	81.6	83.9	82.7	81.7	81.1	80.3	80.6	81.3	83.4	84.6	85.5	82.5	80.2	78.0			141.0
	OVERALL MEASURED	96.2	101.2	102.4	101.5	100.1	101.0	99.6	99.7	100.9	102.3	104.0	105.0	104.9	106.0	105.7			153.0
	OVERALL CALCULATED	94.6	101.0	102.2	101.2	99.6	100.5	98.9	98.9	100.2	101.7	103.3	104.5	103.8	104.7	104.4			
	PNDB	109.4	116.1	116.9	116.1	114.5	115.7	112.9	113.2	113.9	114.9	116.4	118.0	116.3	116.6	115.2			

TABLE A16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AUG 3 1971
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MATCHED ASSY
CASE, ROTOR TIP BLEED
07482 4013103-557
VIEW AFT LOOKING FWD
VIEW FWD LOOKING AFT
TO BE CHG BY D-CID ONLY

Figure 1A

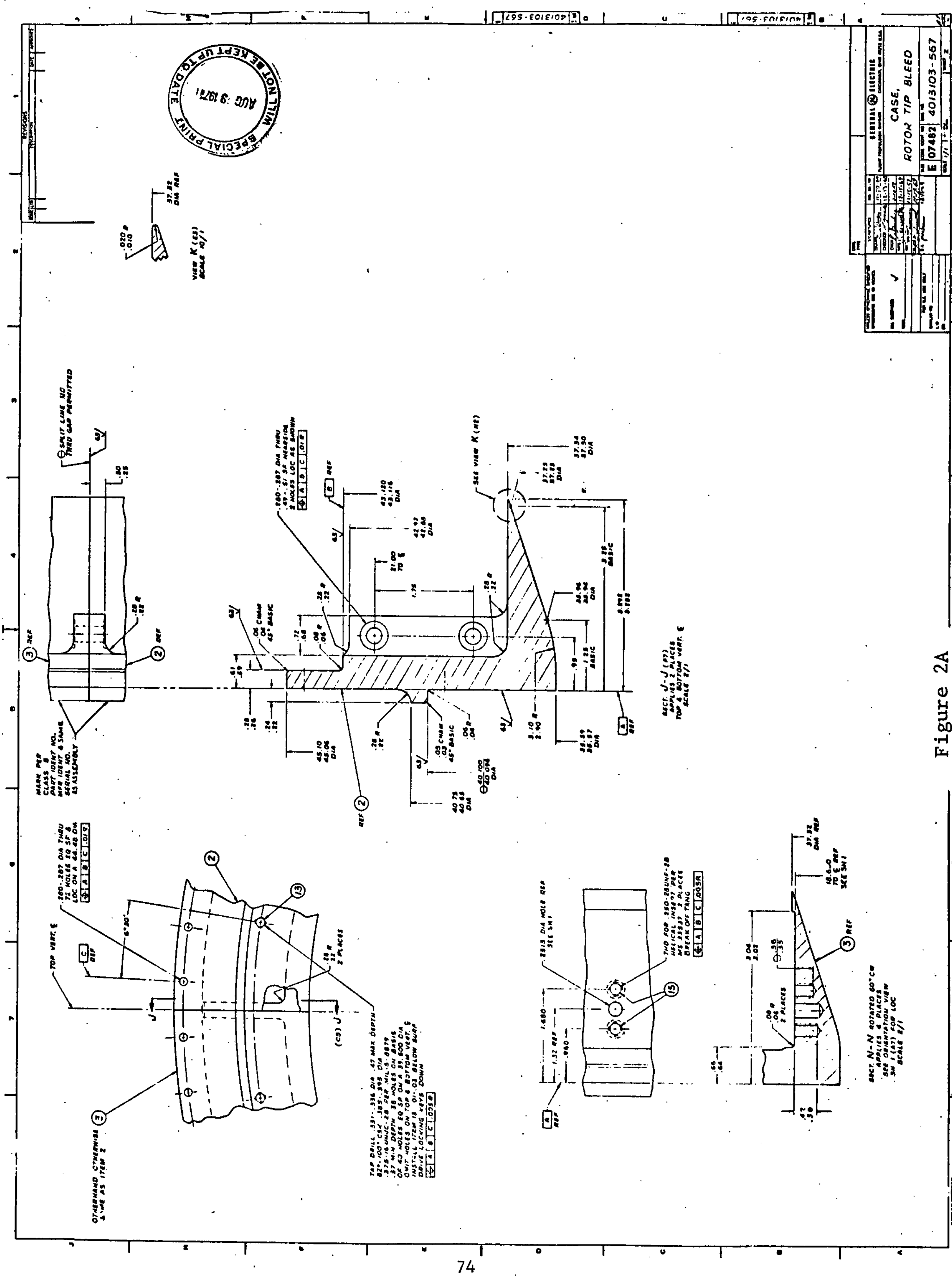
GENERAL ELECTRIC
CASE, ROTOR TIP BLEED
4013103-567
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Figure 2A

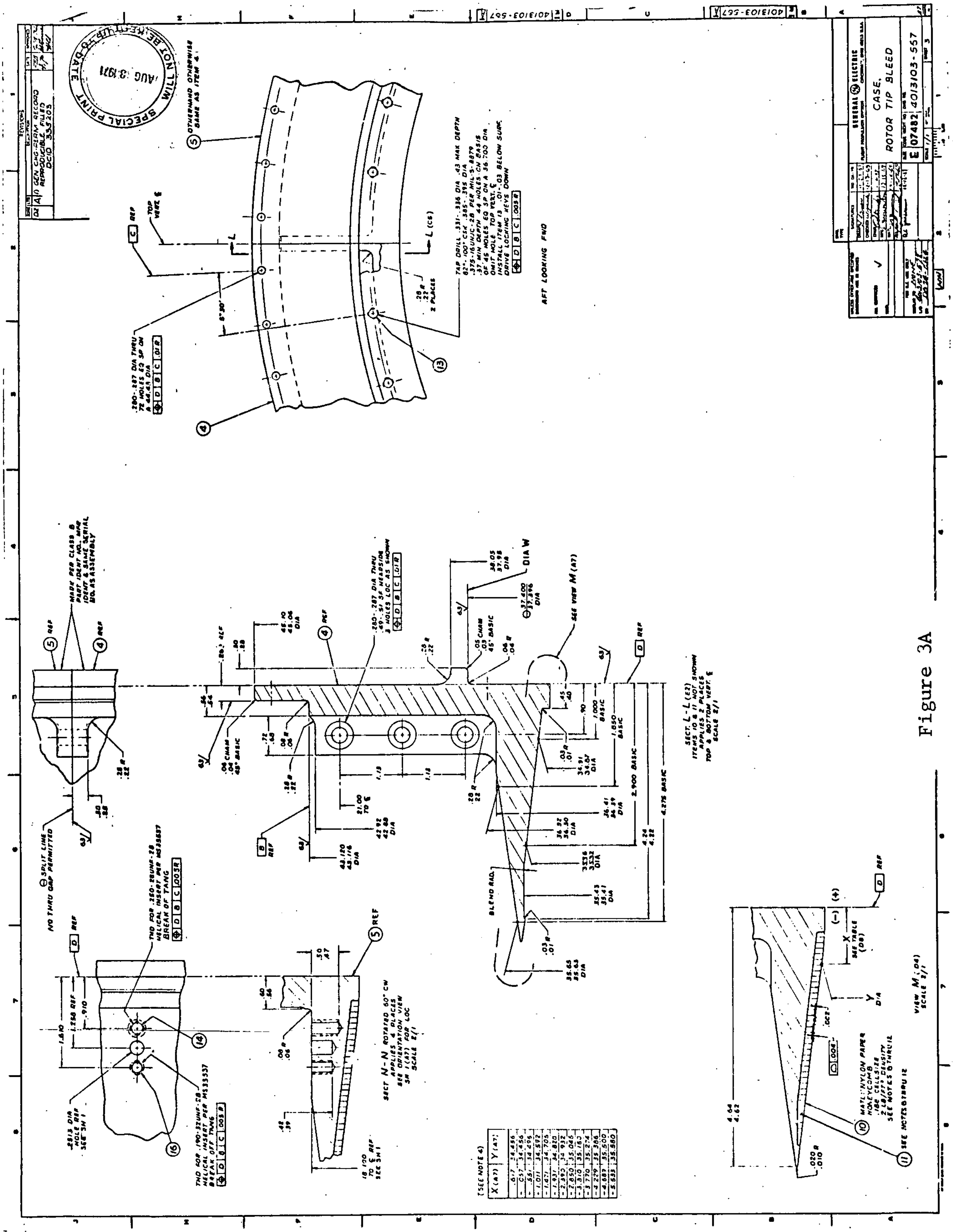


Figure 3A

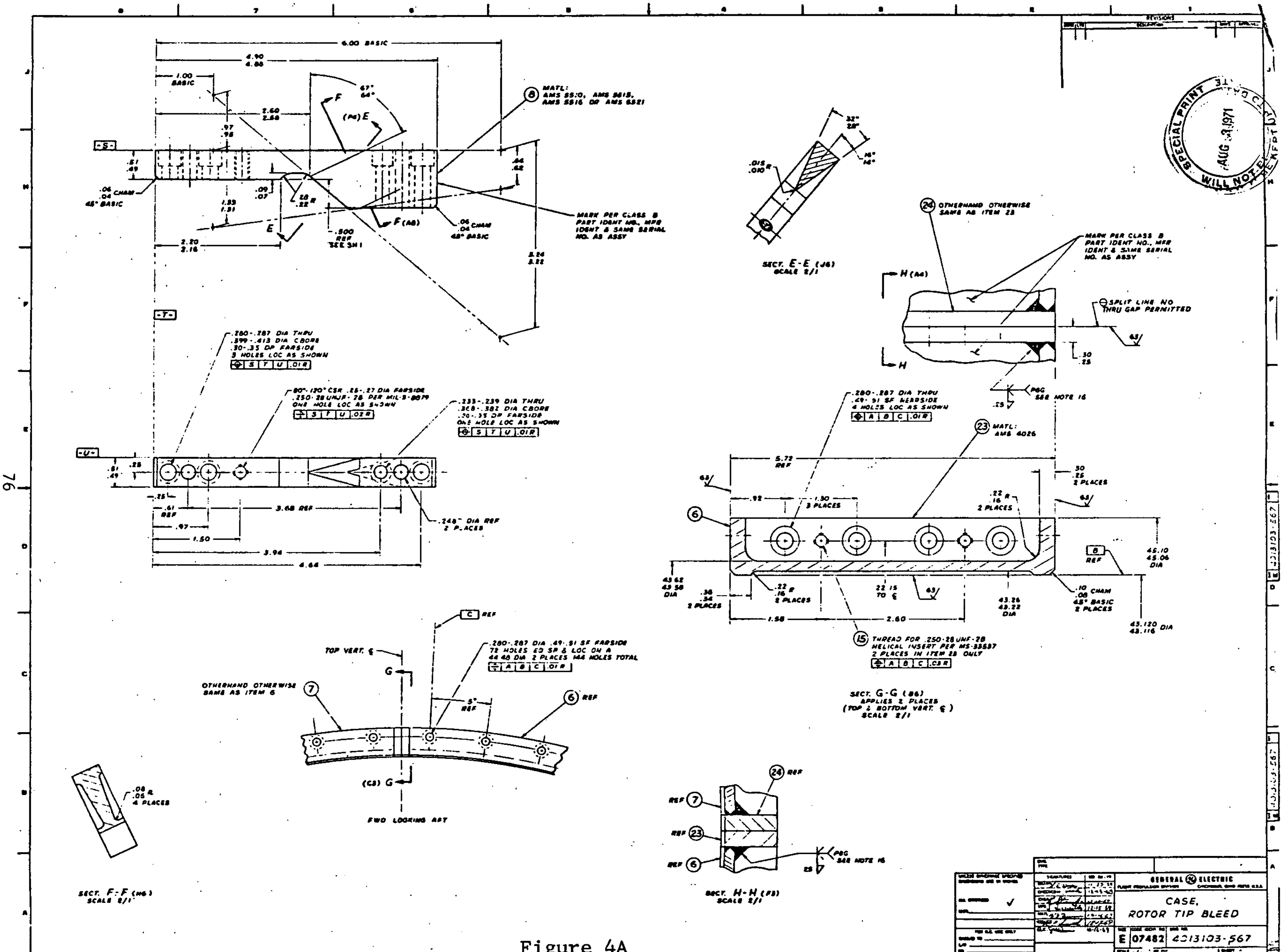
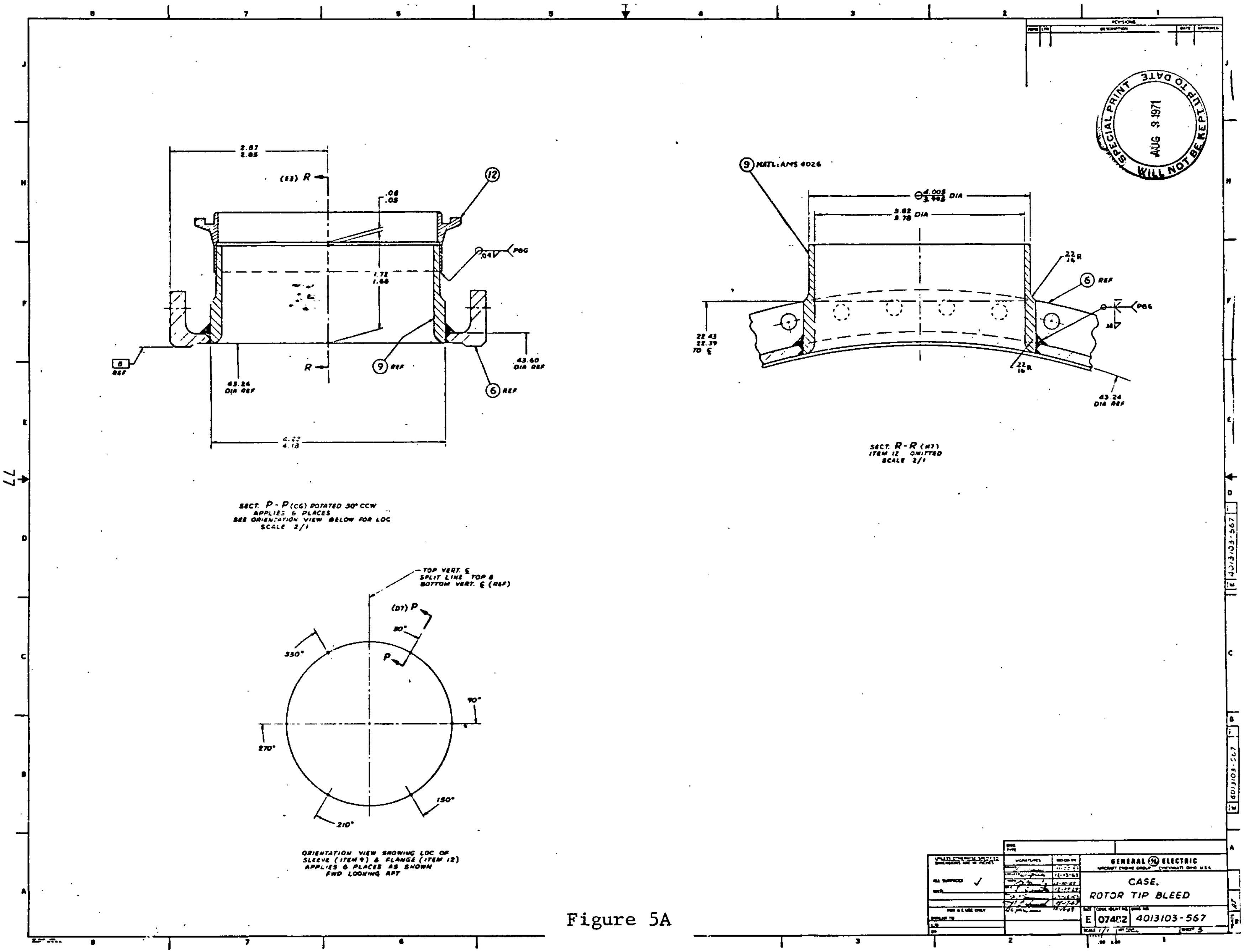

SECT. E-E (J6)
SCALE 2/1
SECT. G-G (B6)
APPLIES 2 PLACES
(TOP & BOTTOM VERT. ℄)
SCALE 2/1
FWD LOOKING AFT
SECT. F-F (H6)
SCALE 2/1
SECT. H-H (F3)
SCALE 2/1
GENERAL ELECTRIC
CASE,
ROTOR TIP BLEED
07482

Figure 4A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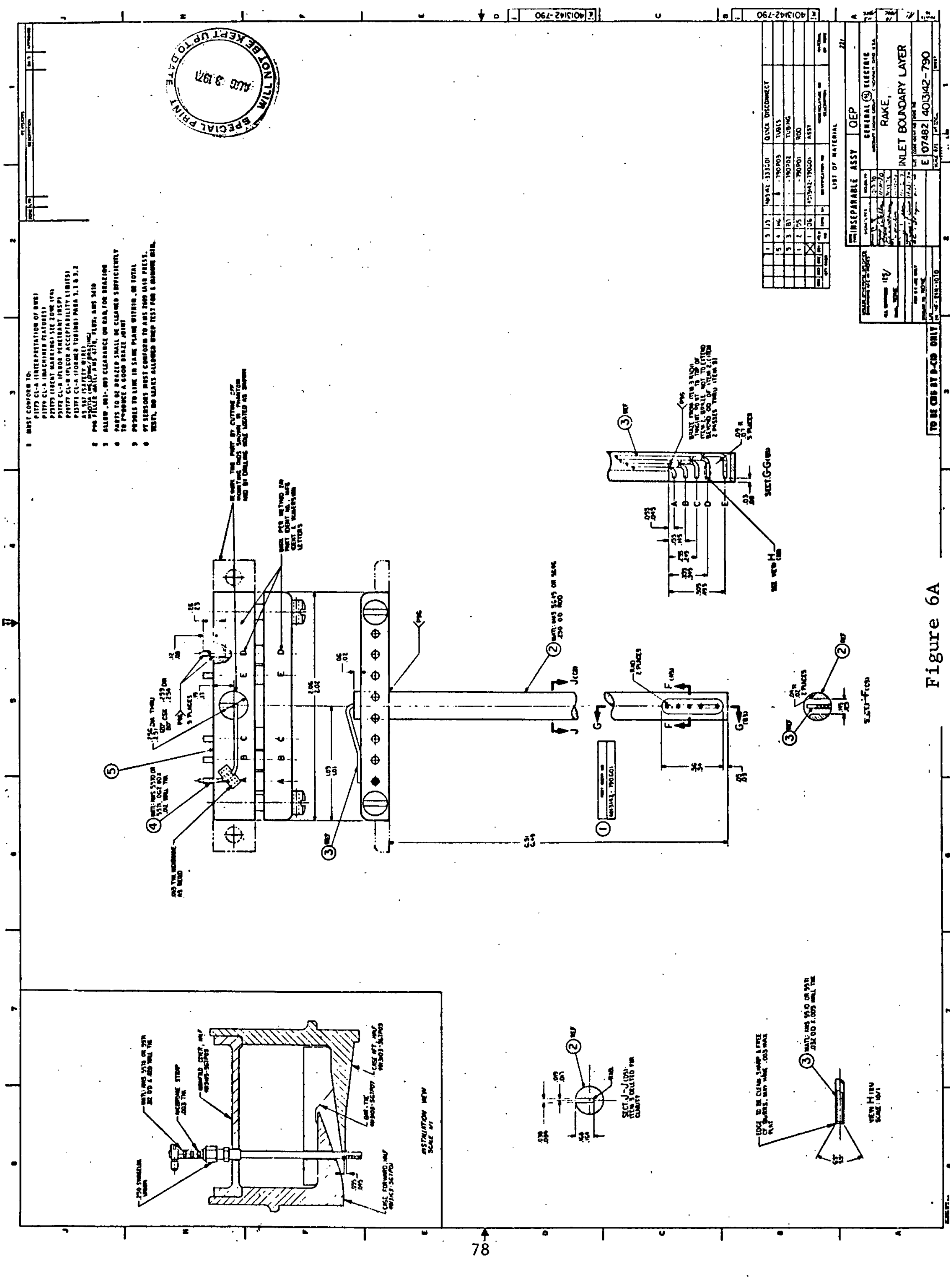
SECT. P-P (C6) ROTATED 30° CCW
APPLIES 6 PLACES
SEE ORIENTATION VIEW BELOW FOR LOC
SCALE 2/1
SECT. R-R (H7)
ITEM 12 OMITTED
SCALE 2/1
MATL. AMS 4026
ORIENTATION VIEW SHOWING LOC OF
SLEEVE (ITEM 9) & FLANGE (ITEM 12)
APPLIES 6 PLACES AS SHOWN
FWD LOOKING AFT
TOP VERT. ℄
SPLIT LINE TOP &
BOTTOM VERT. ℄ (REF)
30°
90°
150°
210°
270°
330°
GENERAL ELECTRIC
CASE,
ROTOR TIP BLEED
E 07482 4013103-567

Figure 5A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INSEPARABLE ASSY
QEP
GENERAL ELECTRIC
RAKE,
INLET BOUNDARY LAYER
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LIST OF MATERIAL
QUICK DISCONNECT
TUBES
TUBING
ROD
ASSY
SECT. G-G
SECT. J-J
VIEW H
INSTALLATION VIEW
TO BE CHG BY D-CED ONLY

Figure 6A

IX. Nomenclature

Bar.	Barometric pressure in inches of mercury (newtons/sq. meter)
f_1	Fan blade passing frequency fundamental
f_2	Fan blade passing frequency second harmonic
F_n	Net engine thrust
Freq.	1/3 octave band center frequencies
H	Absolute humidity in grams/cubic meter (kilograms/cubic meter)
Loc.	Location of testing
M_o	Aircraft Mach Number
N/θ	Fan rotational speed, corrected to standard day
NFA	Actual physical fan speed in rpm (radians/second)
NFD	Design fan speed in rpm (radians/second)
NFK	Fan speed corrected to standard day in rpm (radians/second)
OAPWL	Overall sound power level calculated by summation of power level spectra from 50 Hz to 20K Hz.
OASPL	Overall sound pressure level calculated by summation of sound pressure levels at each 1/3 octave from 50 Hz to 20K Hz.
O.G.V.	Outlet guide vane
PNL	Perceived noise level; a calculated, annoyance weighted sound level
PTO	Peebles Test Operation
PWL	Sound power level, Re 10^{-13} watts
QEP	Quiet Engine Program
Radial	Arc distance in feet (meters)
SL	Sideline
SLS	Sea level static

SPL	Sound pressure level, Re .0002 $dynes/cm^2$
T_{amb}	Dry bulb ambient temperature in degrees Fahrenheit (degrees Kelvin)
T_{wet}	Wet bulb ambient temperature in degrees Fahrenheit (degrees Kelvin)
V_{plane}	Aircraft velocity

dB	Decibel
Hz	Hertz (cycles per second)
PNdB	Perceived noise decibel

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